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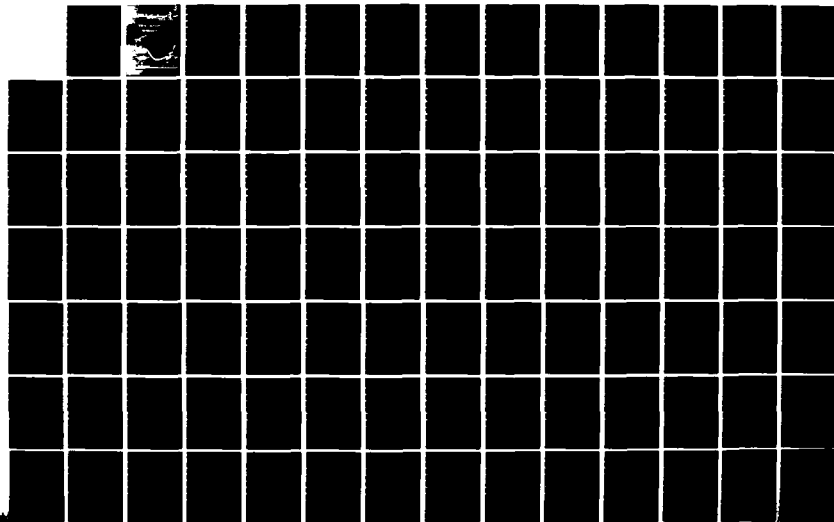
RED RIVER OF THE NORTH RECONNAISSANCE REPORT: TWO
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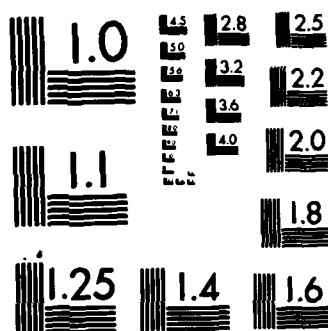
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problems, to determine priorities for immediate and longrange action, and to identify the capabilities of various governmental units for implementing the actions.

The information developed in this report has been combined with information developed in the other subbasin reports to produce a main report covering the basin as a whole. The various flood control measures discussed in this and in other subbasin reports are combined in the main report to develop the outline of an integrated flood control plan for the basin within the context of a comprehensive plan.

The Two Rivers Subbasin occupies 1,112 square miles of the northern Minnesota portion of the Red River Basin and includes portions of Kittson and Roseau counties. It is bordered on the north and east by the Roseau River Subbasin (which extends into Canada), on the southeast by the Tamarac River Subbasin, and on the west, northwest, and southwest by the Main Stem Subbasin. The northern edge is generally within 2.5 miles of the U.S.-Canadian boundary for 20 miles in the north-central part of Kittson County. The subbasin has achieved a legal status as a water resource planning unit through the formation of the Two Rivers Watershed District in 1957.

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Final Report

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RECONNAISSANCE REPORT:
RED RIVER OF THE NORTH BASIN,
TWO RIVERS SUBBASIN



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I. THE STUDY AND REPORT

I. THE STUDY AND REPORT

This report is one of 23 subbasin reports produced by the St. Paul District Corps of Engineers in connection with a reconnaissance report for the whole of the Red River Basin. The reconnaissance report is itself part of the overall Red River of the North Study, which was initiated by Congress in 1957 in order to develop solutions for flooding problems within the basin.

The purpose of a reconnaissance study is to provide an overview of the water and related land resource problems and needs within a particular geographic area, to identify planning objectives, to assess potential solutions and problems, to determine priorities for immediate and long-range action, and to identify the capabilities of various governmental units for implementing the actions.

The Two Rivers Subbasin is a water resource planning unit located in the northern Minnesota portion of the Red River Basin. This report describes the social, economic, and environmental resources of the subbasin, identifies the water-related problems, needs, and desires, and suggests measures for meeting the needs, particularly in the area of flood control.

The report was prepared almost entirely on the basis of secondary information. However, some telephone contacts were made to verify information and to acquire a more complete picture of local conditions. The only comprehensive report available on the subbasin is the 1972 Overall Plan, the Two Rivers Watershed District, in parts of Kittson and Roseau counties, which was published by the Minnesota Water Resources Board. Other published sources on the subbasin include:

1. Work Plan for Watershed Protection and Flood Prevention, Middle Fork of Two Rivers Watershed, Kittson County, Minnesota, which was published in 1960 by the U.S. Department of Agriculture, Soil Conservation Service and describes the watershed and its flooding problems and possible solutions.
2. Work Plan for Watershed Protection and Flood Prevention, North Branch of Two Rivers Watershed, Kittson and Roseau counties, Minnesota, which was published in 1962 by the U.S. Department of Agriculture, Soil Conservation Service and describes the watershed and discusses ways to alleviate flooding along the tributaries in the western part of the subbasin.

3. Application for Assistance in Planning and Carrying Out Works of Improvement Under Watershed Protection and Flood Prevention Act, Badger-Skunk Creek Watershed, State of Minnesota, which was published in 1966 by the State Soil Conservation Commission and is an application for Federal assistance.
4. Transcript of Minutes of Public Hearing for Flood Control and Related Purposes on Two Rivers, Minnesota, held at Hallock, Minnesota, January 20, 1967, which was published by the St. Paul District Corps of Engineers and is a transcript of the public meeting containing the citizens views on the advisability of providing improvements for flood control and water-related purposes in the subbasin.
5. Collection of letters concerning proposed improvements for flood control in the Two Rivers Subbasin, which was published by the St. Paul District, Corps of Engineers in 1967.
6. Comprehensive Water Management study by Barr Engineering under contract with the State of Minnesota.

In addition, the subbasin received partial coverage in the Souris-Red-Rainy River Basins Comprehensive Study, which was published by the Souris-Red-Rainy River Basins Commission in 1972, and in the Red River of the North Basin Plan of Study, which was published by the St. Paul District Corps of Engineers in 1977.

The information developed in this report has been combined with information developed in the other subbasin reports to produce a main report covering the basin as a whole. The various flood control measures discussed in this and in other subbasin reports are combined in the main report to develop the outline of an integrated flood control plan for the basin within the context of a comprehensive plan. The main report will consider the possibility of various water resource-oriented agencies serving as vehicles for implementing flood damage reduction actions and undertaking additional study needs.

II. DESCRIPTION OF STUDY AREA

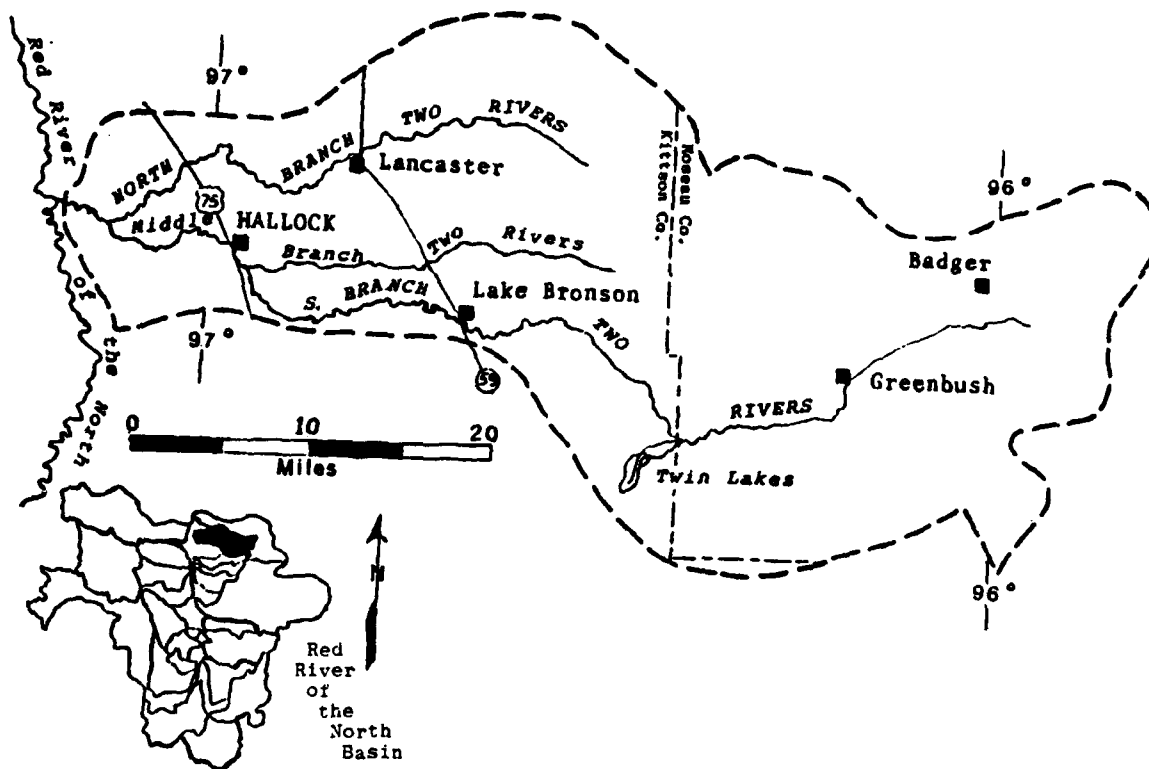
II. DESCRIPTION OF STUDY AREA

The Two Rivers Subbasin (Figure I) occupies 1,112 square miles of the northern Minnesota portion of the Red River Basin and includes portions of Kittson and Roseau counties. It is bordered on the north and east by the Roseau River Subbasin (which extends into Canada), on the southeast by the Tamarac River Subbasin, and on the west, northwest, and southwest by the Main Stem Subbasin. The northern edge is generally within 2.5 miles of the U.S.-Canadian boundary for 20 miles in the north-central part of Kittson County. The subbasin has achieved a legal status as a water resource planning unit through the formation of the Two Rivers Watershed District in 1957.

In contradistinction to most of the other subbasins in the Red River Basin, the land within the Two Rivers Subbasin is flat because the entire area lies within the former bed of glacial Lake Agassiz. Although the land is flat, in the eastern portion of the subbasin there is a fall toward the west of 12 to 15 feet per mile. In the western portion, the fall is not more than one or two feet per mile. Because the land is inclined to the west, there is a considerable difference in elevation between the headwaters and the mouth of Two Rivers. Near the mouth (in the west) the elevation is about 790 feet above mean sea level, and at the headwaters (in the east) the elevation is about 1,030 feet above mean sea level.

West of the north-south line through Lancaster in Kittson County, the surface materials consist of clayey lake bed deposits. Sandy lake bed and lake washed sandy clays predominate east of the line. Several recessional beaches of Lake Agassiz cross the subbasin. The most prominent is Campbell Beach, which crosses extreme southwestern Kittson County and has been followed by the Route of State Highway 11 running through Badger and Greenbush. In the central portion of the subbasin there are large marsh areas, and in both the east and west-central portions there are large tracts of forests.

The major water features of the subbasin are the Two Rivers, its branches, and its tributaries. The main stem of the Two Rivers is only



Source: Gulf South Research Institute.

Figure I. TWO RIVERS SUBBASIN

a few miles long and enters the Red River about 13 miles from the U.S.-Canadian border. Three principal branches--the North Branch, Middle Branch, and South Branch--comprise the river system. The Middle and South branches join to form the Two Rivers just upstream from Hallock, and the North Branch empties into Two Rivers seven miles west of Hallock. The South Branch follows the southeast side of Campbell Beach and cuts through the ridge to the west near Pelan.

The flat topography causes the subbasin to be poorly drained, and an extensive system of ditches was built after the turn of the century. The flatness also makes it difficult to distinguish between the drainage area of the Two Rivers and adjacent drainage areas. To the north, for example, occasionally overflow waters from the Roseau River enter tributary ditches in the Two Rivers Subbasin through Big Swamp. Within the subbasin, there is also an overlapping of drainage areas, and the Middle Branch receives some overflow from the tributaries of the South Branch.

III. PROBLEMS, NEEDS, AND DESIRES

III. PROBLEMS, NEEDS, AND DESIRES

The primary water-related problems, needs, and desires in the Red River Basin are flood control, fish and wildlife conservation and enhancement, recreation, water supply, water quality, erosion control, irrigation, wastewater management, and hydropower. Various water-related problems, needs, and desires have been identified for the Two Rivers Subbasin in previous planning reports on the basis of analysis of conditions and public and agency comments. The list of problems, needs, and desires for the subbasin is the same as the list for the Red River Basin as a whole, except for hydropower. Each problem is discussed separately below, with an emphasis on flooding problems.

Flooding Problems

Nature of the Problems

Flooding in the subbasin results from snowmelt runoff and high intensity summer rains. Floods from snowmelt tend to occur at least every other year at the time of spring breakup. Although such floods do not result in high direct crop damages, planting may be delayed, which results in depressed yields.

It is common for channels and ditches to be clogged with ice and snow during periods of snowmelt runoff. When this happens, floodwaters escape the channel and flow across cropland until an open channel is reached, which adds to planting delays by from one week to ten days. In addition to limiting the growing season, the floodwaters cause considerable erosion on plowed ground.

Flood damage from high-intensity summer storms occur less often than spring snowmelt floods. However, such floods are generally characterized by high peak flows that cause damage to maturing crops or render crop harvest difficult or, in some cases, impossible.

Two separate types of flooding occur: the most damaging type associated with river bank overflow (overbank flooding) and another type caused by runoff from snowmelt or heavy rainfall impounded by plugged culverts and ditches within sections of land bounded by roadways on earthen fill

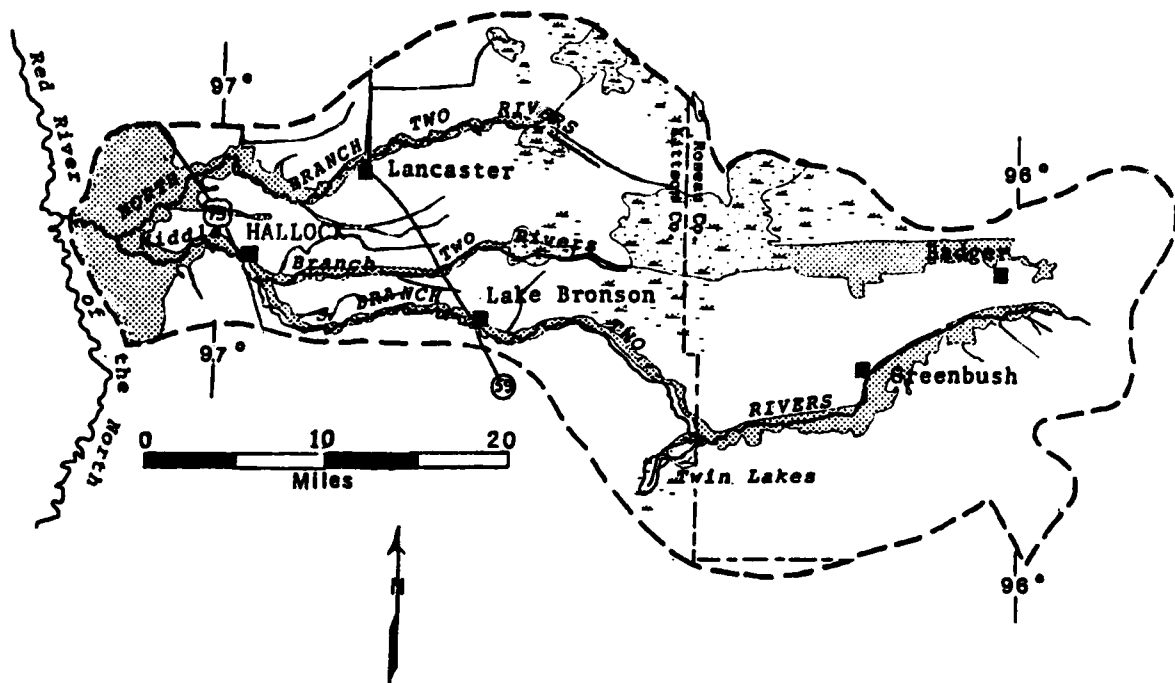
(overland flooding). In overland flooding, the trapped water slowly accumulates until it overflows the roadways and inundates section after section of land as it moves overland in the direction of the regional slope until reaching river or stream channels. Topography also has a bearing on flooding problems. The subbasin has the typical sequence of swamps, beach ridges, and valley plain characteristic of other Red River subbasins. The ancient lake bottom is generally level from north to south and slopes to the west. In some parts of the eastern portion of the subbasin, the fall is quite rapid--as much as 12 to 15 feet per mile. Because of the flatness of the Great Bog area, floodwaters frequently cross watershed boundaries in the upper reaches of the subbasin. Some overland flows that cover great tracts of land originate from the Roseau River and others from the North Branch of Two Rivers and Judicial Ditch No. 95.

Because of the large marsh areas, the branches of the Two Rivers do not have a defined floodplain in the eastern part of the subbasin. The North and South Branches become entrenched within narrow stream valleys through the western half of the subbasin, except in the flat valley plain in the vicinity of the Red River, where floodwaters escape the river channels and move overland, damaging cropland, roads, bridges, and farmsteads.

Flooding conditions within the subbasin are further exacerbated by the fact that peak flows on the North, Middle, and South Branches often correlate with peak flows on the Red River, because of the latter's long flood peak. This causes the subbasin flow to back up and inundate large areas in the flat valley plain. Conversely, the subbasin contributes to floods on the main stem of the Red River. The subbasin contains about 2.8 percent of the total drainage area of the Red River Basin, but runoff from the subbasin constitutes 3.5 percent of the total Red River volume at the U.S.-Canadian boundary.

Location and Extent

Figure II depicts the 100-year floodplain for the subbasin. Prior to this study, no attempt had been made to publish a delineation of the entire subbasin. A number of sources were investigated in order to produce the present delineation, including: (1) U.S. Geological Survey (USGS) Flood Prone Area Maps at 1:24,000 scale; (2) Federal Insurance



Source: Gulf South Research Institute.

Figure II. 100-YEAR FLOODPLAIN

Administration flood maps (various scales); (3) published secondary sources describing flooded areas; and (4) USGS 7 1/2 minute topographic maps.

The map is thus a composite of available sources supplemented by inferences where necessary. Because the sources were incomplete and based on surveys differing in purpose and accuracy, it should be understood that Figure II constitutes a generalized delineation and is intended only for general planning purposes. A more complete description of sources and limitations is given in Appendix A.

According to the delineation in Figure II, the entire subbasin floodplain totals 120,000 acres. Major components include: the western end of the subbasin associated with main stem Red River flooding--28,000 acres; the North Branch--20,000 acres; the Middle Branch--54,000 acres; and the South Branch--18,000 acres. These figures include a total of 56,000 acres designated as marsh floodplain associated with the three branches. An additional 38,000 acres of marsh occurs in the vicinity, but is not considered to be part of the floodplain. (This point is discussed further in Appendix A.)

The upper portion of the North Branch floodplain consists almost entirely of marsh (14,000 acres). Additional marsh not delineated in Figure II as floodplain totals 12,000 acres. The lower portion of North Branch begins about seven miles east of Lancaster, traverses the beach ridge area in a confined channel, and widens in the vicinity of Northcote to over a mile before losing definition some five miles east of the Red River.

The Middle Branch is basically similar to the North Branch, except that the floodplain in the upper end is much larger, and that of the lower end is much smaller. The former totals 52,000 acres, of which 40,000 acres is delineated as marsh floodplain. An additional 20,000 acres of marsh in the vicinity is not considered part of the floodplain. Approximately five miles east of Hazelton, Middle Branch enters the beach ridge area. The relatively confined floodplain in this segment totals approximately 2,000 acres.

The South Branch floodplain is somewhat different in configuration, even though it traverses the same three physical areas. The upper segment

from the area south of Badger to where the river turns northwest some 11 miles west of Greenbush averages approximately a mile in width. From that point to Lake Bronson, a confined channel connects two small marsh areas. The entire upper segment totals 14,000 acres, of which the marsh floodplain accounts for only 2,000 acres. Non-floodplain marsh, on the other hand, is estimated to be 6,000 acres in this area. From Lake Bronson to Hallock, the floodplain is relatively contained, but widens to one mile five miles downriver, where the floodplain loses definition because of its proximity to the Red River.

Flood Damages

The primary areas affected by flooding throughout the subbasin's floodplain are urban, agricultural and environmental in nature. Hallock and Lake Bronson are the only urban areas in the subbasin that are subject to flooding. The only damage categories taken into account in the computation of average annual damages are urban and rural.

Present average annual damages in the subbasin are estimated at \$313,700. This is a very small figure in that it accounts for less than one percent of the Red River of the North basinwide average annual flood damage total. Urban and rural are the two basic classifications into which average annual damages are separated. Damages to residences, businesses (commercial and industrial), and public facilities (streets, utilities, sewers, etc.) are reported as urban damages. Damages to crops, other agricultural assets (fences, machinery, farm buildings, etc.), and transportation facilities are reported as rural damages. Rural damages account for 92 percent of the total average annual damage figure for the subbasin, and urban damages account for the remaining eight percent.

Urban damages sustained during the 1979 flood event amounted to \$22,000. No urban flood damages were reported to have resulted from the 1975 flood event. Average annual urban flood damages in the subbasin are estimated at \$26,000. A more detailed breakdown of these urban flood damage figures is presented in Table 1. Urban damages resulting from the 1979 flood event included \$11,000 in residential damages, \$8,800 in business-related damages, and \$2,200 in public damages. Average annual urban flood damages are estimated at \$13,000 in residential damages, \$10,400 in business damages, and \$2,600 in public damages.

Table 1
TWO RIVERS SUBBASIN, ESTIMATED 1979 AND AVERAGE
ANNUAL URBAN FLOOD DAMAGES
(Thousands of 1979 Dollars)

Category	Urban Flood Damages	
	1979	Average Annual
Residential	\$11.0	\$13.0
Business	8.8	10.4
Public	2.2	2.6
Total	\$22.0	\$26.0

Sources: Red River of the North Basin Plan of Study, April, 1977; Post Flood Report, 1979; and Gulf South Research Institute.

Average annual rural flood damages and the rural flood damages incurred in the 1975 and 1979 flood events are shown in Table 2. Rural flood damages sustained in both the 1975 and 1979 flood events greatly exceeded the average annual damages in the subbasin. Rural flood damages sustained in the 1975 flood event include \$4.9 million in crop damages, \$3.0 million in other agricultural damages, and \$42,959 in transportation damages. The 1979 flood event resulted in rural flood damages that included \$755,000 in crop damages, \$180,000 in other agricultural damages, and \$105,000 in transportation damages. In comparison, average annual rural flood damages are estimated at \$190,400 in crop damages, \$63,500 in other agricultural damages, and \$33,800 in transportation damages. Total rural flood damages were \$7.9 million in the 1975 flood event, \$1.0 million in the 1979 flood event, and \$267,700 on an average annual basis.

Environmental Concerns

Most of the native prairie lands in the subbasin have been removed for agricultural development. Woodlands and wetlands have also been eliminated to a large extent. Woodlands in the western portion are confined to the floodplains of the North, Middle, and South Branches of Two Rivers and provide excellent habitats and travel corridors for wildlife in this disturbed area. Forests are also prominent in the area between Lancaster and Pelan as well as along the floodplain of the South Branch to Badger.

Table 2
TWO RIVERS SUBBASIN, ESTIMATED 1975, 1979 AND
AVERAGE ANNUAL RURAL FLOOD DAMAGES
(Thousands of 1979 Dollars)

Category	Year		Average Annual
	1975	1979	
Crop	\$4,884.4	\$ 755.0	\$190.4
Other Agricultural	2,964.2	180.0	63.5
Transportation	43.0	105.0	33.8
TOTAL	\$7,891.6	\$1,040.0	\$287.7

Sources: Red River of the North Basin Plan of Study, April, 1977; Post Flood Reports, 1975, 1979; and Gulf South Research Institute.

These habitats need to be protected because of their high wildlife value. Wetlands, other than Type 1, are confined mainly to the eastern portion of the subbasin and consist of lakes, potholes, marshes, and peat bogs. These wetlands also need to be conserved, protected, and enhanced whenever possible (Minnesota Water Resources Board, 1972; North Central Forest Experiment Station and Minnesota State Planning Agency, no date; Soil Conservation Service, 1960, 1962; U.S. Fish and Wildlife Service, 1980; Upper Mississippi River Basin Commission, 1977).

Water quality problems associated with municipal and agricultural pollution have degraded waters in Two Rivers to the point that the streams are unsuitable for game fish propagation. Problems occur with excessive or high levels of BOD, turbidity, fecal coliform, nutrients, and low dissolved oxygen. At present, no significant fisheries exist in the Two Rivers system, and inadequate water supplies in the Joe River preclude any fishery value in this watershed. Additionally, drainage of small ponds and wetland areas for agricultural development is also probably affecting aquatic organisms. There is a need to improve these conditions in the subbasin (Minnesota Water Resources Board, 1972; Soil Conservation Service, 1960, 1962; U.S. Fish and Wildlife Service, 1979a; Upper Mississippi River Basin Commission, 1977).

Recreation Problems

A significant amount of land (approximately 104,900 acres) is designated for recreational purposes within the subbasin; however, the majority of the acreage (74,762 acres) is included in wildlife management areas and Lake Bronson State Park (29,830 acres). Although these areas provide important recreational opportunities, there are only 300 acres of additional recreational lands in the subbasin. These areas are primarily small municipal parks and school athletic fields.

Recreation areas are concentrated in the central portion of the subbasin. The western portion of the subbasin is limited in recreation resources because of the lack of large water bodies.

Fishing resources are severely limited in the subbasin by municipal and agricultural pollution in Two Rivers. Water quality problems have rendered the river system unsuitable for recreation purposes and for game fish propagation.

Recreation potential throughout the subbasin has been affected by the drainage of wetlands and potholes in the west, causing the loss of valuable wildlife habitat and contributing to agricultural runoff problems. The woodlands and wetlands of the floodplains of the Two Rivers branches and the lakes, potholes, and marshes of the eastern portion of the subbasin provide habitat and should be protected from further clearing and drainage.

Water Quality Problems

The Upper Mississippi River Basin Commission (1977) reported that municipal and agricultural pollution causes low dissolved oxygen levels and excessive nutrient concentrations in Two Rivers during low flows. The Minnesota Pollution Control Agency indicated that turbidity problems take place periodically, as do problems that are probably the result of pollution from domestic sewage. Violations occur with ammonia and fecal coliforms, and nutrients and BOD are very high at times. The high BOD loadings are the probable cause of the low dissolved oxygen levels. These problems have resulted in waters that are unsuitable for whole-body contact recreation and game fish propagation in Two Rivers.

Problems with groundwater supplies in the subbasin consist of high dissolved solids, iron, and manganese in bedrock aquifers and high levels of iron and manganese in the glacial drift aquifers (Upper Mississippi River Basin Commission, 1977). The Minnesota Pollution Control Agency (1975) reported that water wells in the community of Badger have been contaminated by septic tank wastes.

Water Supply Problems

The western portion of the subbasin is subject to severe water supply problems with respect to both farm and municipal uses. Problems result because of the brackish or saline character of the groundwater and the limited yield obtained from the impermeable lake bed soils. Water supplies in the west generally contain too high a salt content for human and animal consumption and irrigation. Surface water must be stored and utilized for these purposes. Many farmers and small towns must rely on water hauling from the Hallock reservoir. The shallow wells that produce water generally need to be supplemented by surface water supplies. The water shortage seriously hampers livestock farming in the subbasin. Dug-out pits are used by farmers to catch and store water as a source of livestock water supply. During periods of extreme low precipitation, acute water supply problems may develop.

Erosion Problems

Erosion occurs as floodwaters move across croplands and carry soil from the surface of unprotected fields. Eroded soil is deposited into ditches and drainage systems, resulting in decreased water holding capacity and less functional systems. Ditch bank erosion is common in the constructed channels because of high velocity flows and under-designed channels. Erosion occurs in many places where side drainage or flood water enters constructed channels or natural waterways. Agricultural problems result when wind erosion causes infertile sandy materials to be deposited on cultivated soils.

Irrigation

The amount of irrigated acreage in the subbasin in 1970 was approximately 900 acres, all of which were located in Kittson County. By 1975, the

amount of irrigated acreage in Kittson County had increased to 3,685 acres. Marshall and Roseau counties reported no irrigated acreage in 1975.

Although irrigation practices in Minnesota have been increasing steadily since the 1930's, the irrigation potential in this subbasin is unknown. This is due to the fact that information about the area's surficial sand aquifers has not been adequately documented. At best, the soils in the subbasin are only moderately suited to irrigation.

Wastewater Management

Five municipal point sources have been identified in the subbasin. These dischargers and their problems and needs are shown in Table 3. Two of these communities have had problems: Greenbush and Badger. Greenbush operates primary and secondary stabilization ponds that function in parallel during turkey slaughtering season and in series during the remainder of the year. BOD and fecal coliform concentrations are within established limits, but total suspended solids are excessive. Improved pretreatment at the slaughtering operation will reduce the suspended solids load. Badger is a nonsewered community that has had reports of contamination of wells from septic tank wastes. They are low on the Municipal Needs List and, as such, would not soon receive a grant to improve wastewater treatment with a sewer system and wastewater treatment facility. The treatment facilities are new at Lake Bronson, Hallock, and Lancaster and in most cases are operating below capacity with no known problems. Both Lake Bronson and Lancaster need to improve their effluent reporting (Minnesota Pollution Control Agency, 1975).

Hydropower

There are no hydroelectric facilities in operation in the subbasin, and no future development is planned. There are no lakes in the subbasin, and no other water bodies have enough holding capacity to properly supply the water needed for a hydropower plant.

Table 3
PROBLEMS AND TREATMENT NEEDS OF POINT SOURCE DISCHARGERS IN THE TWO RIVERS SUBBASIN

Discharger Description	Receiving Water	Discussion of Problems	Treatment Needs	Other Planning Considerations
Greenbush	South Branch Two Rivers	TSS too high	Reduce TSS Improve Operation	Turkey Plant may require more Pretreatment
Lake Bronson	South Branch Two Rivers	Submit effluent reports	Expected to be adequate	Population projected to decline
Hallock	South Branch Two Rivers via ditch	No known problems	Expected to be adequate	Population projected to remain stable
Lancaster	North Branch Two Rivers via Coulee Creek	Submit effluent reports	Expected to be adequate	Population projected to decline
Badger	South Fork Two Rivers	Septic tank problems	Construct facilities	Low on MNL. Apply for permit 180 days prior to discharge

Source: Minnesota Pollution Control Agency, 1975.

Public Perception of Problems and Solutions

The public's perception of problems and solutions in the subbasin is reasonably well defined because the Corps of Engineers has held public meetings in this area in the late sixties, and the subbasin has been organized as a watershed district. The primary documents for the identification of public perceptions are the Two Rivers Watershed District Overall Plan and the Transcript of Minutes of Public Hearing published by the St. Paul District Corps of Engineers.

A number of land and water-related problems confront residents of the subbasin, but the most important is recurrent flooding conditions throughout the area resulting in damage to crops, farms, and urban improvements. During the late 1960's, some flood control resulted from installations of projects in parts of the Middle Branch and North Branch of Two Rivers. These areas of improvement and control, however, are generally in need of expansion.

Flood damage is still regarded as a serious problem along the South Branch. The Overall Plan, published by the Minnesota Water Resources Board in 1972, prescribes a number of proposed solutions to the problem centering on: flood control and prevention, floodplain and channel improvement, agricultural water management, and six other categories, including recommendations regarding inter-watershed flow.

The transcript of the public hearing held at Hallock on January 20, 1967 provides a good insight into public perception of problems and solutions. Federal, state, and local governmental agencies and various private interests, including railroad and business interests, organizations, and individuals attended the meeting, with speakers indicating their desire for flood control improvements. A subsequent public meeting discussed local cooperation requirements. A plan of survey for flood control and related purposes was recommended in 1971, but there are no authorized or planned projects in the subbasin at the present time.

Additional evidence for interest in flood control measures is contained in public hearings held in East Grand Forks in 1978 and 1979 before subcommittees of the Committee on Public Works and Transportation of the U.S. House

of Representatives. From these documents, it is evident that residents of the Red River Basin consider flood control to be the primary water related need for the area and that they are interested in whatever solutions may be proposed by Federal, state, or local agencies.

A comprehensive water management study is being conducted by Barr Engineering and this report should further document public perceptions of problems and solutions.

IV. DESCRIPTION OF SUBBASIN RESOURCES

IV. DESCRIPTION OF SUBBASIN RESOURCES

This section of the report discusses the primary resource conditions within the subbasin that are water related and that would be affected by a comprehensive water and related land resources plan centering on flood control measures.

Social Characteristics

Prior to 1970, the subbasin experienced a steady decline in population, which was primarily due to a decrease in agricultural employment. During the last 30 years, changes such as increased mechanization and consolidation of farms resulted in a large decline in the number of farm laborers. A lack of industrial employment opportunities within the subbasin added to the unemployment problems, and large numbers of people moved out of the subbasin to urban areas. By 1970, farm employment began to stabilize and other sectors increased. During the 1970's, the population increased slowly and the subbasin experienced a reversal of the high net out-migration rate. Between 1970 and 1977, the population increased by 5.9 percent, reaching a figure of 7,160. The net in-migration rate was more than 4.5 percent.

The largest town in the subbasin is Hallock (1,441), which sustained a 2.4 percent decrease in population over 1970. Hallock serves as the Kittson County seat and as the trading center for the surrounding agricultural areas. The other small towns in the area include Greenbush (824), Lancaster (420), Lake Bronson (348), and Badger (343), all of which had increases in population over the last decade.

The population of the subbasin is predominantly rural (53 percent). The population density remained at six persons per square mile between 1970 and 1977, which is one of the lowest population densities in the entire Red River Basin.

Communities within the subbasin are close-knit, as can be partially illustrated by length of residence in the area. Almost the entire population (approximately 99 percent) resides in Kittson and Roseau counties, in which 82.6 percent and 84.2 percent of the residents, respectively, own their homes. Approximately 61 percent of the 1970 Kittson County population was living in the same residence in 1965, and 65 percent was living

in the same county. In Roseau County, approximately 65 percent had occupied the same residence in 1965, and 84 percent were living in the same county. Both counties have a high number of employed persons who work in the county of residence (89 percent in Kittson County and 93.6 percent in Roseau County).

The population is primarily of Scandinavian background. Forty percent of the Roseau County population is of Norwegian descent, and 40 percent of the population in Kittson County is of Swedish background. The minority population is too small to be identified.

Economic Characteristics

Employment

The sharp decline of farm employment in the subbasin between 1940 and 1970 was not offset by moderate increases in other sectors, particularly trade and services. The Northwest Region of Minnesota, of which this subbasin is a part, had a farm employment of almost 24,000 people in 1940. By 1970, this figure had decreased by more than 70 percent (to 6,700). This contributed to an overall decrease in employment. Agricultural employment has now stabilized, and other sectors continue to increase. As a result, total subbasin employment increased from 2,432 in 1970 to 3,007 in 1977, which was a 24 percent increase.

The agricultural sector has been, and will continue to be, the largest employment sector, accounting for nearly one-half of the total labor force. It is followed in importance by trade and services. Manufacturing employment is only a small part of the total labor force.

Unemployment in the subbasin has averaged nine percent during the last decade. Employment is high during the spring and summer from agricultural activities and during the fall from harvesting and processing activities. All activities decrease during the winter.

Income

Total personal income for the subbasin increased from \$29 million to \$75 million between 1969 and 1977 (as expressed in 1979 dollars). Farm income accounts for more than 75 percent of the total personal income, and cash grain sales amount to more than 70 percent of the farm income.

In the eastern part of the subbasin (Roseau County), livestock and its products account for 30 percent of the total farm income. Average per capita income during the same years increased from \$4,320 to \$10,513, which was more than 25 percent higher than the 1979 state average income figure of \$8,314. This elevated per capita income is due primarily to farm incomes, especially in Kittson County. Of the 87 counties in Minnesota, Kittson ranked 79th in farm income level in 1969. In 1973, it was in first place, and in 1975, it was in seventh place.

Business and Industrial Activity

Agriculture

The subbasin's economy is primarily based on agriculture and related activities. Approximately 52 percent (or 370,000 acres) of the subbasin's land area is under cultivation, and another 21 percent is devoted to pasture. Livestock production is more important in the eastern half of the subbasin. In 1978, Roseau County was the leading county in Minnesota in the production of stock sheep and lambs, and it ranked seventh in the production of beef cows.

The major crops grown in the subbasin are identified in Table 4. Wheat is the leading crop, accounting for almost 50 percent of the harvested acreage, followed by barley, hay, oats, and sunflowers (43 percent, collectively, of the harvested acres). There are also minor acreages of flax, potatoes, sugarbeets, and rye.

Table 4
1978 CROP STATISTICS, TWO RIVERS SUBBASIN

Crop	Harvested Acres	Yield Per Acre	Total Production
Wheat	138,550	38.5 bushels	5,334,175
Barley	43,350	49.9 bushels	2,163,165
Hay	33,300	2.0 tons	66,600
Oats	29,500	59.6 bushels	1,758,200

Source: Gulf South Research Institute.

The western portion of the subbasin is characterized by level clay soils. This part of the subbasin is largely a cash grain producing area. The chief crops are wheat, barley, oats, hay, flax, and potatoes. In 1978, Kittson County ranked third in the state in the production of wheat, fifth in the production of potatoes, and sixth in the production of barley. In the eastern part of the subbasin, the major crops grown are spring wheat, barley, oats, hay, and sunflowers. Roseau County ranked third in 1978 in the production of oats, sixth in the production of wheat, seventh in the production of sunflowers, and ninth in the production of barley. Beef cattle, dairy cattle, and sheep are the principal livestock enterprises.

Cropping patterns within the floodplain of the Two Rivers are similar to those throughout the subbasin, but there is greater emphasis on specialty crops. The primary crops grown within the floodplain are small grains and sunflowers.

Manufacturing

Although manufacturing employment has increased moderately in the subbasin over the last decade, it is still only a small part of the total employment. Most of the ten establishments in the subbasin are involved in the manufacture of agriculture-related products. Four of the establishments produce fertilizer, one makes ready mix concrete, and three produce foods (honey, potato sausage, butter, and ice cream). According to the Minnesota Department of Economic Development, there are no new industries being developed in the subbasin. Table 5 groups the manufacturers according to their Standard Industrial Code (SIC) numbers.

Table 5
MANUFACTURING ESTABLISHMENTS, TWO RIVERS SUBBASIN

SIC	Description	Estimated Employment
20	Food and Kindred Products	20
27	Printing and Publishing	10
28	Chemicals and Allied Products	55
32	Stone, Clay, and Glass Products	8
TOTAL		93

Source: 1979-80 Minnesota Directory of Manufacturers.

Trade

In 1977, total trade receipts for the subbasin exceeded \$58 million) expressed in 1979 dollars). More than 65 percent (or \$38.2 million) of the receipts were wholesale trade. Retail trade and selected service receipts were \$20.5 million and \$2.1 million respectively, in 1977.

Transportation Network

The entire subbasin is rural in nature, and a good transportation network is necessary to move farm produce to market and receive services from the metropolitan areas. The two major north-to-south highways include Federal Highways 75 (through Hallock) and 59 (through Lake Bronson and Lancaster). The subbasin is crossed from east-to-west by State Highway 11 (through Greenbush and Badger), which intersects Interstate 29 in North Dakota. Interstate 29 provides fast, efficient access to Grand Forks and the Fargo-Moorhead area. Highways 59 and 75 intersect Interstate 94 south of the subbasin, and this route travels to Fargo-Moorhead as well as Minneapolis-St. Paul.

The subbasin is also traversed by three rail lines that parallel highways 11, 59, and 75 and travel to the Port of Duluth and to the Minneapolis-St. Paul area. Two natural gas pipelines pass through the subbasin near Hallock in the far western part of the area and near Lake Bronson. A crude oil pipeline generally parallels Highway 75 and runs to the Port of Duluth. The natural gas pipelines run to Duluth and the Minneapolis-St. Paul area. There are very small, limited-facility airports located in Greenbush, Lake Bronson, and Lancaster and a larger airport with a lighted runway in Hallock. The Lake Bronson and Hallock airports are located very near the river and may be subject to flooding. Each of the rail lines and the three major highways cross the river also, and in some areas may be subject to flooding.

Land Use

Approximately 52 percent of the subbasin is under cultivation, 20.7 percent is pasture, 16.2 percent is forest, and 10.5 percent is water and marsh. Urban development is minimal.

The western third of the subbasin is primarily agricultural land, and there are concentrations of wooded areas along the streambanks.

The central portion of the subbasin has agricultural land and pasture interspersed with forest, and most of the water and marsh areas are located there. The eastern third of the subbasin has less forest area and more land under cultivation.

Environmental Characteristics

Climate

Climatic data is based on records from the U.S. Weather Bureau Station at Hallock, Minnesota. Mean monthly temperatures range from 60°F in the summer to 2°F in the winter. The extreme recorded temperatures are -51°F to 100°F. The average date of the last killing frost is May 28 and that of the first killing frost in the fall is September 15, an average frostfree period of 115 days. Average annual precipitation, including snowfall, is 20 inches, with 16 inches (80 percent) occurring during the growing season from April through September. The short growing season and limited rainfall restrict the types and varieties of crops grown.

Geology

The subbasin lies within the Western Lake Section in the Central Lowland Province of the Interior Plains. Bedrock consists of undifferentiated Precambrian igneous and metamorphic rock overlain by Ordovician undifferentiated limestone and dolomite, with shale and sandstone at the base. Generally fine-grained, poorly cemented sandstone, and interbedded shale Cretaceous deposits overlie Ordovician deposits.

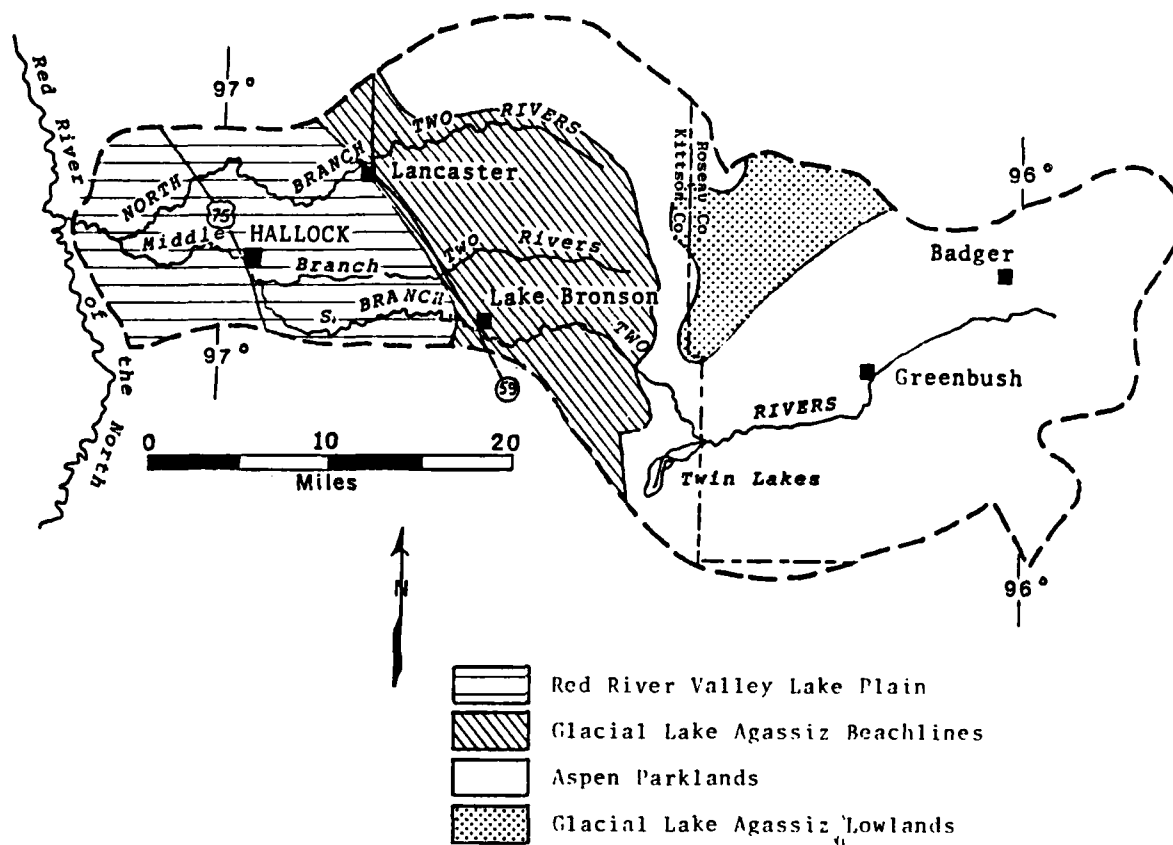
Glacial drift overlies bedrock and consists of clay and silt glacial lake deposits in the western segment of the subbasin, bordered by a bank of beach ridges composed of sand and gravel. The eastern portion of the subbasin is predominantly till, with a significant portion of peat, muck and generally swampy areas in the north-central area. Prominent beach ridges (particularly the Campbell Beach) extending from southeastern Kittson County through Greenbush and Badger obstruct the flow of water from the southeast to the northwest.

Biology

The elm-ash-cottonwood and aspen-birch associations are the principal Forest types occurring in the subbasin. The elm-ash-cottonwood type

is located mainly along the North, Middle, and South Branches of Two Rivers from its confluence with the Red River to the general region of their headwaters. This community is particularly well-developed in the floodplains in the western part of the subbasin and in the vicinity of Pelan. Major species include American elm, green ash, cottonwood, boxelder, black willow, hackberry, and silver maple. The aspen-birch type is particularly abundant in the central region between Lancaster and the southern boundary of the subbasin at the Kittson-Roseau county junction. In the eastern part of the subbasin, it becomes more scattered, with an intermixing of small woodlots and some larger, contiguous tracts. Dominant species in this forest type include aspen, paper birch, and red-osier dogwood. Further descriptions of the forested areas of the subbasin have been reported which indicate that they are comprised of aspen and scattered areas of scrub oak with no commercial value; some areas have been burned over (North Central Forest Experiment Station and Minnesota State Planning Agency, no date; Soil Conservation Service, 1960, 1962; Wanek, 1967).

Four major wetland zones are found in the subbasin: Red River Valley Lake Plain, Glacial Lake Agassiz Beachlines, Aspen Parklands, and Glacial Lake Agassiz Lowlands (Figure III). The Lake Plain zone is found in the flatter segments of the river valley floor, which once contained shallow wetlands and native prairie; agricultural development has eradicated most of these areas. The Glacial Beachline zone once had numerous shallow wetlands. Long, narrow marshes probably still remain scattered throughout this sandy region, since it has been relatively undisturbed. The Aspen Parkland zone is the dynamic transitional zone between grassland and coniferous formations. Potholes and shallow marshes are interspersed with aspen groves, which have been limited by fire and farming. The Glacial Lowlands zone is characterized by extensive peatlands and stretches of sandy mineral soil. The best representations of wetlands in this zone are found to the east of the Red River Basin. Wetland types that are known, or possibly occur, in the subbasin are as follows: Type 1--seasonally flooded basins and flats, Type 3--shallow fresh marshes, Type 4--deep fresh marshes, Type 5--open fresh marshes, Type 6--shrub swamps, Type 7--wooded swamps, and Type 8--bogs (Mann, 1979; Soil Conservation Service, 1960, 1962; U.S. Fish and Wildlife Service, 1980).



Source: Mann (1979).

Figure III. MAJOR WETLAND ZONES IN THE TWO RIVERS SUBBASIN

Habitats important to wildlife in the subbasin consist of any remaining prairie remnants and the wetlands and woodlands. Native prairie affords excellent habitats for plants and animals dependent upon grassland situations. The combination of prairie and wetlands in its original form provided a dynamic and diverse ecosystem with an abundance of vertebrate and invertebrate organisms. Existing wetlands afford breeding, nesting, rearing, feeding, and resting habitats for a number of migratory and resident wildlife including waterfowl, big and small game, and furbearers. Woodlands also furnish significant habitats for feeding, resting, breeding, and nesting and contain a greater variety of wildlife species than any other major habitat type in the subbasin. As mentioned earlier, the floodplain forest along the three branches of Two Rivers in the western portion of the subbasin undoubtedly provides an important migration and travel corridor for wildlife. The eastern portion of the subbasin, and some parts of the central portion, contain the best quality habitats for wildlife since they are relatively undisturbed (Soil Conservation Service, 1960, 1962; U.S. Fish and Wildlife Service, 1980).

The white-tailed deer, moose, and black bear are the big-game animals of the subbasin. In 1978, a total of 722 deer were harvested from Kittson County and 1,093 from Roseau County. During this same period, eight bears were taken in Roseau County. Small game mammals and upland game birds include the snowshoe hare, jackrabbit, Hungarian partridge (1/100 miles), sharp-tailed grouse (1-6 adult males/square mile), and ruffed grouse. Typical furbearers consist of the muskrat, mink, beaver, raccoon, and red fox. A total of 101 species of breeding birds have been reported in the region encompassing the subbasin (Region 1N of the Minnesota Department of Natural Resources). These include the following: non-native pest birds--three species; non-native game birds--one species, native game birds--10 species, and native nongame birds--87 species. Common nongame breeding birds include the killdeer, cliff swallow, western meadowlark, and red-winged blackbird. Waterfowl production in the wetlands is important and consists of species such as the mallard, blue-winged teal, and wood duck. Eleven species of amphibians and reptiles have

been reported from Kittson and Roseau counties and are composed of herpetofauna such as the northern leopard frog, red-bellied snake, western plains garter snake, and eastern tiger salamander. Twenty-four species of nongame mammals have been identified from the two counties and include species such as the masked shrew, little brown bat, short-tailed weasel, eastern chipmunk, Gapper's red-backed vole, and meadow jumping mouse (Henderson, 1978, 1979; Henderson and Reitter, 1979; literature cited in Mann, 1979; Soil Conservation Service, 1960, 1962; U.S. Fish and Wildlife Service, 1980).

Two Rivers actually consists of a main stem (Middle Branch) and two other branches, the North Branch and the South Branch. The headwaters of all three branches have interconnecting ditches that were constructed to aid in flood control. In addition, a ditch was constructed to create a water flow from the Little Joe River to the North Branch (U.S. Fish and Wildlife Service, 1979).

The dominant species of fish within the Two Rivers system include northern redhorse, quill back, buffalo, common shiners, and other rough and forage fishes. Few, if any, game fish are present. Since there is no significant fishery on Two Rivers, the Minnesota Department of Natural Resources has classified it as a rough fish, forage fish (Class IV) stream (U.S. Fish and Wildlife Service, 1979). One impoundment, Lake Bronson, supports a moderate population of walleye and northern pike.

In slight contrast to the fish resources, a variety of mussel species were reported by Cvancara (1970). A total of eight species were represented, four of which were represented by live specimens. The live species were Lasmigona complanta, Anodonta grandis, Anodontoides ferussacianus, and Lampsilis siliquoidea. The other four species, Fusconaia flava, Lasmigona compressa, Strophitus rugosus, and Lampsilis ventricosa, were represented by empty shells only.

Kittson County has three game lakes (494 total acres) that are normally less than six feet deep and contain water year round. One fish lake (no winterkill) is located in the county also. In addition, one walleye lake, which has a dominant population of walleye, yellow perch, and northern pike, occurs in Kittson County. No significant lakes are located within Roseau County (Peterson, 1971).

Water Supply

Water supplies in the subbasin are restricted. Shallow wells provide limited quantities of water sufficient for farm needs in the eastern portion. Some water is obtained from shallow wells in the sandy beach ridge areas and occasional sand and gravel lenses in the glacial till. The western portion experiences greater water supply problems because of the unsuitable character of the groundwater and the limited yield. Water hauling from the Hallock reservoir is widely utilized by farmers and neighboring villages for human consumption, crop spraying, and some livestock use. Many farmers also use dug-out pits for catching and storing surface water for livestock purposes. The city of Hallock obtains its water supply from the South Branch of Two Rivers. The latest statistics from the Minnesota Department of Health show that Hallock uses approximately 62,050,000 gallons of water per year. The treated river water provides an ample amount of water for the city itself and neighboring towns and farmers. However, during extreme or extended low precipitation periods, water supply problems for the municipalities could develop.

Water Quality

Surface water quality data for the Middle Branch of the Two Rivers is shown in Table 6. Turbidity standards were in violation in 17 percent of the samples. As discussed earlier in the Problems and Needs section, other problems occur that appear to be caused by domestic sewage pollution. Fecal coliforms were in violation in 66 percent of the samples, with a reported maximum of 33,000/100 ml. The ammonia standard was exceeded in 37 percent of the samples, and nitrate (5.3 mg/l maximum), phosphorus (3.5 mg/l maximum), and BOD (30 mg/l maximum) were very high at certain times. The dissolved oxygen standard was exceeded in seven percent of the samples, with a minimum value reported of 4 mg/l.

Table 7 gives groundwater quality data for four communities in the subbasin. These data show that the water is generally very hard, with dissolved solids at or above the criteria of 500 mg/l. The pH was in violation in only one community (Hallock, with a value of 9.4), but iron and manganese concentrations are excessive in most communities. Sulfate

SURFACE WATER QUALITY STANDARDS
NEAR HALLS

Description	Flow (cfs)	Temperature (°F)	D.O. (mg/l)	BOD (mg/l)	SS (mg/l)	Fecal Coliform (MPN/100)
Water Quality Standards in this Segment		5° change 28-86° Max.	28%	—	28-1.0	200
Monitoring Stations	Average 7-Day 10-Year Low	Average Maximum Percent of Violation	Average Minimum Percent of Violation	Average Maximum Percent of Violation	Average Maximum Percent of Violation	Average Maximum Percent of Violation
Middle Branch, Two Rivers Bridge on U.S. H-75 or. Hallowell 30 reports 1971-74	<1	51 77	0	7.8 4	7 30	1.1 4.5 37 33,000

4-4/1-5/31 - 5-other times

Source: Minnesota Pollution Control Agency, 1975.

Table 6

ITY FOR THE MIDDLE BRANCH OF THE TWO RIVERS
AR HALLOCK FROM 1971-1974

Fecal Coliforms (MPN/100 ml)	TDS (mg/l)	pH	Turbidity (JTU)	Oil (mg/l)	NO ₃ (mg/l)	Phosphorus (mg/l)	TSS (mg/l)
200	700	6.5-9.0	25	28-0.5	10-45	—	—
<u>Average</u>	<u>Average</u>	<u>Average</u>	<u>Average</u>	<u>Average</u>	<u>Average</u>	<u>Average</u>	<u>Average</u>
Maximum	Percent of Violation	Maximum	Percent of Violation	Maximum	Percent of Violation	Maximum	Percent of Violation
224	66	388	0	7.8	—	18	17
1,000	—	—	—	7.3-8.5	—	100	—
			</				

Table 7
GROUNDWATER QUALITY^a FOR COMMUNITIES IN THE TWO RIVERS SUBBASIN

Parameter	Criteria ^b	Greenbush	Lake Bronson	Hallock	Badger
Sample Date		1-61	12-68	11-71	11-71
Well Depth (ft.)		100	80	95	150
Total Hardness	--	430	400	420	440
pH	5.0-9.0	7.8	7.8	--	7.3
Iron	0.3 mg/l	0.72	5.5	0.58	1.5
Manganese	0.05 mg/l	<0.02	0.05	--	0.06
Chloride	250 mg/l	23	6.5	8	7
Sulfate	250 mg/l	270	<5	--	140
Fluoride	1.5 mg/l	0.26	0.34	0.2	2.10
Nitrate Nitrogen	45 mg/l	<1	<1	1.0	<1
Total Dissolved Solids	500 mg/l	--	560	--	--

^aAll chemical data expressed in mg/l, with the exception of pH-standard units.

^bFrom Minnesota Pollution Control Agency (1975) and/or U.S. Environmental Protection Agency (1976)

Source: Minnesota Department of Health, 1977.

was in violation in one community (Greenbush, 270 mg/l) and fluoride in two (Hallock, 1.9 mg/l, and Badger, 2.10 mg/l). No violations are apparent for chlorides or nitrate nitrogen.

Aesthetics

The major aesthetic resource of the subbasin is Lake Bronson State Park (29,830 acres), which is located adjacent to Lake Bronson. The state of Minnesota constructed Lake Bronson Reservoir in 1937. The park offers residents and visitors numerous recreational opportunities and provides an inviting contrast to the open farm country in the western and eastern portions of the subbasin.

In addition to the state park, the wooded areas between Lancaster and Pelan and between Pelan and Badger as well as wooded corridors in the floodplains of the North, Middle, and South branches of Two Rivers provide excellent wildlife habitat and many areas of scenic beauty.

Cultural Elements

Archeological evidence of early (Paleo) man in the subbasin is limited. As late as 9900 B.C., much of the glacial Lake Agassiz plain was poorly drained and marshy and therefore somewhat inhospitable to prehistoric inhabitants. The center of the subbasin retains its swampy character even now. Here, as elsewhere in the Red River Valley, archeological resources are likely to be found along the former shores (strandlines) of Lake Agassiz (Johnson, 1962:126; Saylor, 1975:251). Other high probability areas for prehistoric-historic sites are near the confluence of major streams. In fact, 7 of 11 recorded sites within the subbasin are located near the junction of the North and South branches of Two Rivers and near the confluence of Two Rivers with the Red River. This apparent association of archeological resources with major streams could affect the implementation of flood control measures.

As elsewhere in the Red River Valley, recorded Woodland sites are more numerous than those of other prehistoric culture-periods. This greater incidence of recorded Woodland sites is probably related to their prominent surface visibility (i.e., mounds). Burial mounds of the Arvilla focus are also represented in the subbasin. Arvilla sites are found

generally along the abandoned beach ridges of glacial Lake Agassiz (Wedel, 1961:226; Johnson, 1973:3, 58). The Blackduck focus, similar in artifact assemblages to those of the Arvilla focus, has also been noted in the study area. The Blackduck focus has been tentatively attributed to the Assiniboiné Indians, who treked northward and westward from the Minnesota woodlands to Manitoba, Canada during the 17th and 18th centuries (Wedel, 1961:225).

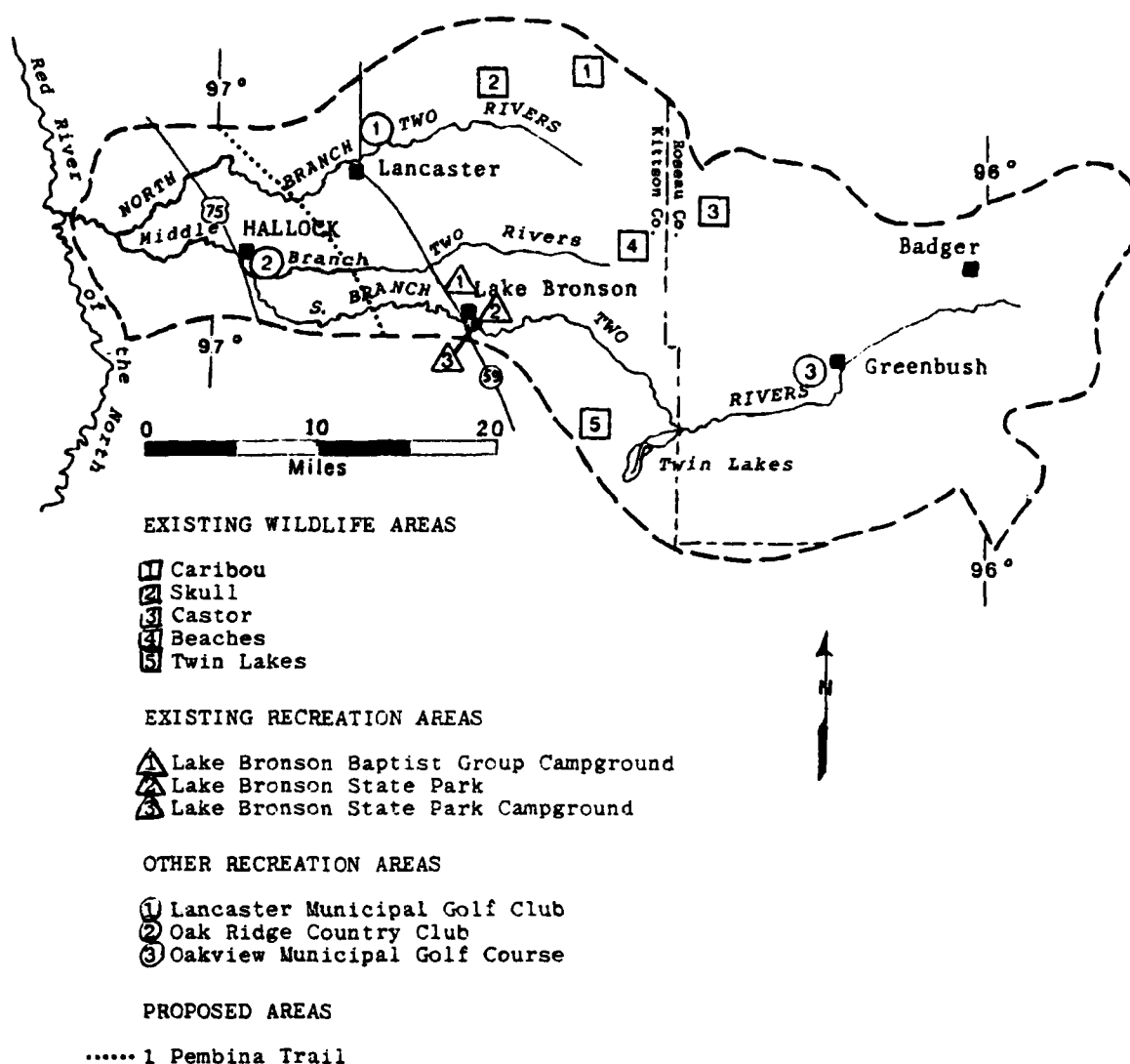
The Cree, Assiniboiné Indians, and other Siouan tribes probably traversed the western plains of the subbasin during historic times (Wedel, 1961:225; Hewes, 1948:49). It was the Chippewa Indians, however, who controlled the subbasin during its most intense period of Euro-American colonization. In treaties of 1863 and 1889, the Pembina and Red Lake Chippewa tribes ceded the flat lands of the subbasin, and settlement by whites increased correspondingly (Blegen, 1963:172-173). Only three historic sites have been inventoried in the study area; of these, one is listed on the State Historic Sites Registry, and none are listed on the National Register of Historic Places.

Recreational Resources

Recreational resources in the subbasin are relatively limited. Most of the area's approximately 104,900 acres of recreational lands are in the central portion of the subbasin where there are extensive forest tracts. There are a total of 21 recreational sites in the subbasin. Area resources comprising 15 or more acres are illustrated in Figure IV. These account for 99 percent of the total recreational lands.

The subbasin's major recreational asset is Lake Bronson State Park (29,830 acres), which is one of only three state parks in the northwestern portion of Minnesota. The park, located two miles east of the town of Lake Bronson, provides a variety of recreational opportunities, including canoeing, picnicking, hiking, and snowmobile trails. A detailed listing of facilities at Lake Bronson State Park and other recreational areas larger than 15 acres is included in Appendix B of this report. The site is on the National Register of Historic Places.

Hunting is popular in the subbasin, as evidenced by the five wildlife management areas comprising 74,762 acres in the central portion. White-tailed deer, rabbits, moose, and some black bear are hunted in the area,



Source: Gulf South Research Institute.

Figure IV. RECREATIONAL RESOURCES

as well as ducks, partridge, sharp-tailed grouse, and ruffed grouse. Furbearing animals include muskrat, mink, beaver, raccoon, and fox.

Stream fishery resources are limited in the subbasin by water quality problems. Fish populations in the rivers are confined to forage fish such as redhorse and buffalo. There is a lake fishery, however, in Lake Bronson. Walleye, yellow perch and northern pike are the most common species.

The major towns have a variety of municipal parks and school athletic fields that provide residents with non-water based recreational activities.

The only proposed recreational site identified in the subbasin is the Pembina Trail, which will retrace a 126-mile ox cart trail through Kittson, Marshall, Pennington, Red Lake, Polk, and Norman counties.

Significant Environmental Elements

Social

The towns of Hallock and Greenbush are the population centers of the subbasin. These towns, as well as the smaller villages of Lake Bronson and Badger, experience periodic flooding problems. In 1969 and 1970, the Soil Conservation Service completed flood control projects for the Middle and North branches, but flooding in the subbasin has not been eliminated.

Flooding problems affect the towns by disrupting normal commercial activity and by causing damages to transportation facilities, utilities, and property. Farmers in the subbasin suffer economic losses because of delays in planting, loss of valuable topsoil, and damages to crops, equipment, and farm buildings. Most of the towns function as agricultural service centers and may experience losses of income as a result of lower crop yields and corresponding decreases in income for farmers that trade in the towns.

Cultural

Most of the archeological sites in the subbasin are associated with the Woodland culture period. Over one-half of these recorded archeological sites are located along Two Rivers and near the confluence of Two Rivers with other streams. This association could have a significant impact on the implementation of structural flood control alternatives.

Soils

The subbasin contains varied soil associations. The western section consists of dark colored, fine textured, lacustrine sediments over calcareous lacustrine clay or sand. Although the soils have fair to poor internal soil drainage and surface drainage is slow because of the level topography, this is considered the best agricultural area in the subbasin.

Sandy loams having fair to poor drainage dominate a vertical strip of soil in the central portion of the subbasin. This belt is fairly well developed agriculturally, with the southern portion having a few low sandy beach ridges. The problems in this area are drainage and wind erosion.

The area to the east is relatively undeveloped agriculturally and includes a variety of soils derived mainly from lake-washed glacial till, lacustrine over till, and scattered peat bogs. The topography is level; consequently, the external drainage is slow, and wind erosion is a potential problem.

Water

Only 0.1 percent of the subbasin's land area is occupied by water. This is one of the lowest percentages of water acreage of any subbasin in the Red River Basin. However, it should be noted that the subbasin contains vast areas of marsh.

Woodlands

The woodlands and brushy areas of the subbasin are significant as habitats for wildlife and serve as a travel corridor for the riparian community in the North, Middle, and South branches of Two Rivers in the predominately agricultural developed areas of the western part. Many of the bottomland and upland woodlands and brushy areas have been cleared and converted to farm lands and now constitute approximately 16.2 percent (or 106,880 acres) of the total area of the subbasin, based on data supplied by the Minnesota Land Management Information Service (MLMIS). Table 8 shows comparisons of the percentages of woodland vegetation within Kittson and Roseau counties between 1969 and 1977. These data indicate that a 5.2-5.9 percent increase has occurred during the eight-year period.

Table 8
COMPARISONS OF COUNTY PERCENTAGES OF
WOODLAND VEGETATION BETWEEN 1969 and 1977

County	Percentage of County Containing <u>Woodland Vegetation</u>		Change in Percent Composition
	1969	1977	
Kittson	9.6	15.5	+5.9
Roseau	28.8	34.0	+5.2

Source: Minnesota Land Management Information Service
(in U.S. Fish and Wildlife Service, 1980).

This increase can be attributed in part to plantings of windbreaks and shelterbelts by local landowners around homesteads and streams and to reestablishment of vegetation in the lower reaches of the streams on former cultivated lands in the floodplain area (U.S. Fish and Wildlife Service, 1980).

Wetlands

The wetlands of the subbasin are significant because of their many functional uses and values such as nutrient entrapment, floodwater retention, groundwater recharge, waterfowl production areas, and habitats for flora and fauna (Cernohous, 1979; U.S. Fish and Wildlife Service, 1980: E.O. 11990, dated 24 May 1977). Data from the MLMIS indicate marshes comprise 68,440 acres (or 10.4 percent) of the total area within the subbasin. No wetland surveys were undertaken by the U.S. Fish and Wildlife Service of Kittson and Roseau counties in 1964 or 1974. However, Mann (1979) indicated that in the Red River Valley Lake Plain (delineated earlier on Figure III), Type 1 wetlands are the residual wetlands in this zone. The wetlands of the Glacial Lake Agassiz Beachline zone are mainly shallow marshes, some of which contain permanent water and are probably Type 3 wetlands. Types 4 and 5 may also occur on the beachline ridges but are not common. Types 6, 7, and 8 may also occur and would probably be limited to the Aspen Parklands and Glacial Lake Agassiz Lowlands zones.

Waterfowl Production Areas

No Federal waterfowl production areas (fee or easement) have been acquired to date by the U.S. Fish and Wildlife Service within the Two Rivers Subbasin.

Wildlife Management Areas

Five wildlife management areas are located in the subbasin. A list of these areas and their acreages and location were presented in the Existing Conditions section for recreation. These areas are considered significant because of the opportunities provided for outdoor recreation and protection and management given to biological resources within their confines.

Threatened or Endangered Species

Three animal species that occur in the subbasin are listed as threatened or endangered: (1) bald eagle, (2) arctic peregrine falcon, and (3) eastern timber wolf. The bald eagles's nesting range encompasses parts of Kittson and Roseau counties, especially near lakes of 100 acres or more. The arctic peregrine falcon does not nest in this area; however, its nesting range covers the entire subbasin. Detrimental effects from chlorinated pesticides (primarily DDT and its derivatives) and destruction of habitat are the main reasons for the decline of the arctic peregrine falcon as well as the bald eagle. The eastern timber wolf once ranged over most of the eastern United States and southeastern Canada. The timber wolf has now been extirpated, however, over most of its former range because of pressures such as trapping and bounty hunting brought on by human civilization. Roseau County is within the primary range of the timber wolf; Kittson County occupies only a small portion of its peripheral range (U.S. Fish and Wildlife Service, 1979b).

Other Important Species

The long-tailed weasel, northern flying squirrel, northern pocket gopher, and northern bog lemming are all species of special or priority status that are considered to be in their peripheral ranges in Roseau and Kittson counties. More detailed studies are needed for these species to determine their exact status. The least weasel is listed as being

rare or uncommon throughout its entire range in Minnesota and deserves more research also. Another rare mammal, the American elk, is a peripheral species occasionally found in this subbasin (Henderson and Reitter, 1979a).

Moyle (1974) listed the eastern greater sandhill crane as a threatened species because of the encroachment of agricultural operations upon its prairie marsh nesting habitat. A few sandhill cranes were reported during the 1978 breeding bird survey from this region (Department of Natural Resources, Region 1N). The State of Minnesota considers the eastern greater sandhill crane threatened, but is not listed Federally. Two other bird species of changing or uncertain status, Franklin's gull and marsh hawk, were also reported during the survey. The status of these two could be improved or become threatened, depending upon future human interference in the marsh areas. The great blue heron is a species of special interest because it requires marsh-like wooded areas (such as coniferous swamps) for nesting, and this habitat type is rapidly vanishing. The great blue heron is not in any immediate danger of becoming threatened, but it should be closely watched. The great blue heron was reported during the 1978 survey also (Henderson, 1978a). No colonial bird nesting sites were recorded in this subbasin by the Minnesota Department of Natural Resources (1978b).

No endangered or threatened species of reptiles or amphibians are found in Minnesota. However, two species of special interest, the smooth green snake and the Canadian toad, have been recorded from Roseau and Kittson counties. The Canadian toad is a western species that has its extreme eastern limits within this region. The smooth green snake has an extensive range throughout Minnesota, but is considered to be of special interest because it is restricted to a limited type of moist, grassy habitat. These areas are usually located in plains or meadows, which have been rapidly yielding way to agricultural operations (Conant, 1975; Henderson, 1979).

Several plants are considered to be rare by the Minnesota Natural Heritage Program (1980). One species, Orobanche fasciculata, is parasitic upon the roots of certain members of the composite family. This plant is found in sandy soils in Kittson County. The other species are found

in two different habitat types: (1) low, wet meadows or prairies and (2) dry plains and hills. The plains and hills produce rare species such as Arabis holboellii var. retrofracta, Helianthus nuttallii, and cat's paws. Plants found in the wet meadows and prairies include meadow-grass, Carex conoidea, Carex obtusata, Juncus gerardii, Scottish asphodel, Eleocharis halophila, and small yellow water buttercup (Lakela, 1965: MacMillan, 1898; Rydberg, 1932).

Natural Areas

No natural and scientific areas have been established within the Two Rivers Subbasin as yet (The Nature Conservancy, no date).

V. FUTURE CONDITIONS

V. FUTURE CONDITIONS

The following is a description of the subbasin's future economic, social, and environmental conditions and resources. This description is presented in terms of "most probable" and "without project" conditions.

Most Probable Economic Conditions

Kittson, the principal component county of this subbasin, is expected by the Minnesota State Planning Agency (MSPA) to briefly stabilize in population and to renew its slight population loss trend after the 1980's. The portion of Roseau County that comprises the remainder of the subbasin is expected by the MSPA to experience modest population gains that will offset the expected declines in Kittson County. This will result in a six percent per decade increase in population for the subbasin. These data along with employment and per capita income estimates throughout the study period (1980-2030) are presented below in Table 9.

The figures in the table were adopted in lieu of the prescribed OBERS E projections, because those projections appear to underestimate growth patterns for the Grand Forks area, both urban and environs. Steady declines through the year 2020 are anticipated by this series. OBERS E and E' projections were, however, designated as the most probable for per capita income and agricultural activity estimates.

Farming will continue to be the economic mainstay of the subbasin, with communities such as Hallock serving as service and retail centers for the large agricultural base. Hallock has been designated as a secondary growth center for the northwest Minnesota region. Local leaders and area planners point to the recurring spring and summer flooding of Hallock and Lake Bronson and the agricultural lands adjacent to the three branches of Two Rivers as the biggest obstacle to economic growth.

Most Probable Agricultural Conditions

Roughly 370,100 acres within the subbasin are currently under cultivation, and wheat, barley, hay, and oats are the principal crops. The estimated value of the total production of these principal crops for 1980 (using October 1979 Current Normalized Prices for Minnesota) is \$24.3 million.

Table 9
TWO RIVERS SUBBASIN, POPULATION, EMPLOYMENT AND
PER CAPITA INCOME PROJECTIONS, 1980-2030

Parameter	1970	1977	1980	1990	2000	2010	2020	2030
Population	6,756	7,160	7,250	7,300	7,400	7,475	7,550	7,600
Employment	2,432	3,007	3,050	3,100	3,150	3,200	3,300	3,350
Per Capita Income (\$)	4,320	10,513	13,700	17,700	23,100	30,000	39,000	50,700

Sources: U.S. Water Resources Council, 1972 OBERS Projections, Series E; Minnesota State Planning Agency; and Gulf South Research Institute.

Projections of total production through 2030 for the principal crops are presented in Table 10. The projected total production for 2030 represents a value of \$41.6 million (using October 1979 Current Normalized Prices for Minnesota).

Table 10
TWO RIVERS SUBBASIN, PRINCIPAL CROPS AND
PROJECTED PRODUCTION, 1980-2030
(Production in Thousands)

Year	Wheat (Bushels)	Barley (Bushels)	Hay (Tons)	Oats (Bushels)
1980	5,494	2,228	69	1,811
1990	6,373	2,585	80	2,101
2000	7,252	2,941	91	2,390
2010	7,802	3,164	97	2,572
2020	8,351	3,387	104	2,753
2030	9,230	3,743	115	3,042

Source: OBERS Series E'; Gulf South Research Institute.

Evaluation of Flood Damages—Future Conditions

A summary of present and future average annual flood damages is presented in Table 11. Assuming a discount rate of 7 1/8 percent, equivalent average annual damages are \$361,400.

Flood damages to residences, businesses, industrial structures, churches, schools, automobiles, house trailers, public property and contents are included in the urban damages category. Damages to streets and utilities (including water, gas, electricity, sanitary sewers, storm sewers, and telephone systems) are also taken into consideration. This category also includes loss of wages, loss of profits, expenditures for temporary housing, cleanup costs, and extra expenses for additional fire and police protection and flood relief.

Table 11
TWO RIVERS SUBBASIN, SUMMARY OF PRESENT AND FUTURE AVERAGE ANNUAL DAMAGES
URBAN, AGRICULTURAL, AND TRANSPORTATION
(October, 1979 Prices, 7 1/8 Percent Interest)

Category	Flood Damages						Average Annual Equivalency Factor	Average Annual Equivalency of Increase	Equivalent Average Annual Damages
	1980	1990	2000	2010	2020	2030			
Urban									
Hallock	26,000	28,600	31,200	33,800	36,400	39,000	0.2903	3,800	29,800
Agricultural									
Crop	190,400	220,900	251,300	270,400	289,400	319,900	0.2903	37,600	228,000
Other Agricultural	63,500	68,600	73,700	76,800	80,000	85,100	0.2903	6,300	69,800
Transportation	33,800	33,800	33,800	33,800	33,800	33,800	--	--	33,800
TOTAL	313,700	351,900	390,000	414,800	439,600	477,800	0.2903	47,700	361,400

Source: Gulf South Research Institute.

Agricultural flood damages consist of crop and pasture damage, which may include costs of replanting, refertilizing, additional spraying, reduced crop yields, loss of animal pasture days, and other related flood losses.

Other agricultural damages consist of land damage from scour and gully erosion and deposition of flood debris; livestock and poultry losses; damages to machinery and equipment, fences, and farm buildings and contents (excluding residences); and damages to irrigation and drainage facilities.

Transportation damages include all damages to railroads, highways, roads, airports, bridges, culverts, and waterways not included in urban damages. In addition, all added operational costs for railroads and airlines and vehicle detours are included.

Future growth of urban flood damages was estimated to be an uncompounded (straight-line) rate of one percent per year for a 50-year period beginning in the base year, with no growth thereafter.

Agricultural crop flood damages were projected to increase at the same rate as crop income projections published in the 1972 OBERs Series E projection report. These crop income projections were prepared by the U.S. Economic Research Service (ERS) for the Red River of the North region. Other agricultural flood damages were projected to increase at one-half of this rate.

Transportation damages are not expected to change throughout the project life because of the long-term economic life associated with such structures as bridges, railways, roads, and culverts. In addition, it has been found that repairs to these types of structures rarely exceed the cost of a new structure, even with frequent flooding.

Most Probable Environmental Conditions

Improvements should occur in Two Rivers with successful implementation of point and nonpoint source pollution plans. Ammonia, fecal coliforms, nutrients, and BOD should improve as point sources are cleaned up. However, nonpoint sources contributing to water quality problems will take substantially longer to rectify. Dissolved oxygen should improve to some degree as pollutant loads diminish, but will continue to reach low concentrations during winter months when ice prevents reaeration.

Barring any significant land use trend changes, woodland habitats are expected to increase over time, and wetlands will decrease in both number and areal extent. The decrease in wetland environs will adversely affect floral and faunal populations dependent upon these habitats. Aquatic biota as well as wildlife will benefit as water quality improves to the point where game fish propagation is possible. Very poor conditions in the Joe River are expected to continue, which will preclude any benefit to the fisheries in this stream.

Without Project Conditions

It is anticipated that the conditions that will prevail over the 50-year planning period in the absence of a plan to alter resource management procedures will be the same as those set forth previously under the most probable future scenario.

VI. EXISTING FLOODPLAIN MANAGEMENT PROGRAMS

VI. EXISTING FLOODPLAIN MANAGEMENT PROGRAMS

Institutions

The development of effective water resources management practices in the subbasin is affected by the large number of Federal, state, and local agencies involved in project planning and implementation. There are 44 Federal agencies with various types of jurisdiction, and 14 directly involved in the water and related land resource planning process. At the state level, 27 agencies are involved. There are also regional commissions, county agencies, and municipal entities. Differences in perspective and problems of coordination hamper the effective and speedy resolution of problems.

The subbasin is aided in water resources development by the inclusion of the area in the Two Rivers Watershed District. The district was formed in 1957 to investigate solutions to flooding, drainage, reclamation, water supply, and other water resource management problems. An overall plan, adopted in 1958, was modified in 1970. In addition, the Kittson County, Roseau County and Marshall County soil and water conservation districts have jurisdiction in the area.

The Corps of Engineers has not constructed any projects in the area; however, the Soil Conservation Service completed channel improvements in the Middle Branch of Two Rivers Watershed in 1969 and a channel improvement and grade stabilization project for the North Branch in 1970.

In addition, the state of Minnesota constructed the Lake Bronson Reservoir for water supply, recreation, and limited flood control purposes in 1937.

The Corps of Engineers, the Two Rivers Watershed District, the Soil Conservation Service, and the towns of Lake Bronson, Hallock, Greenbush, and Badger are the main entities that should be considered in flood control planning for the subbasin. It should be noted that the Northwest Regional Development Commission has developed an overall economic development plan that includes the subbasin area.

Structural Measures

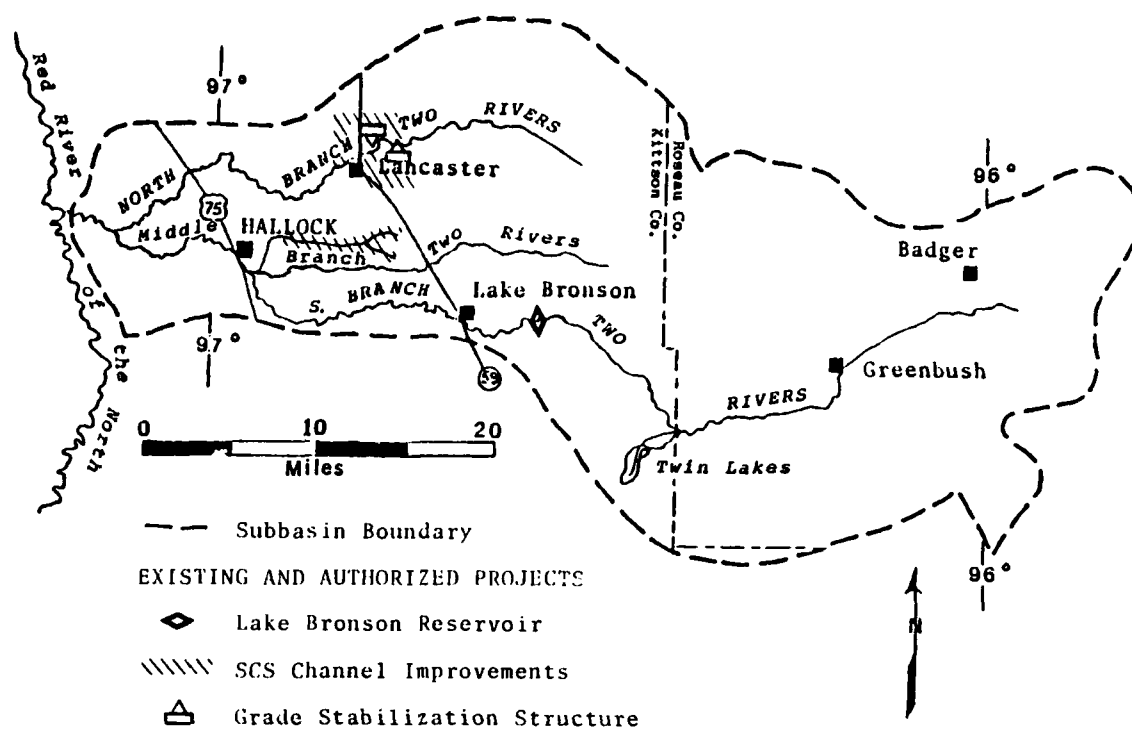
Numerous public and private drainage systems have been constructed throughout the subbasin. These systems generally function satisfactorily for minor floods, but are inadequate for major floods. In addition, they have not been properly maintained and have become clogged because of vegetation growth and siltation.

No floodwater control projects have been constructed in the subbasin by the Corps of Engineers. The Corps has no authorized or planned projects in this subbasin. The Soil Conservation Service (SCS) and local interests under the authority of PL-566 have constructed two floodwater control and agricultural water management (drainage) projects. Structural measures in these projects included 10.6 miles of channel improvement in the Middle Branch of Two Rivers Watershed and 11.5 miles of channel improvement, two grade stabilization structures, and one single purpose wildlife impoundment in the North Branch of Two Rivers Watershed. In 1937, Lake Bronson Reservoir was constructed on the South Fork of Two Rivers two miles east of the town of Lake Bronson. It is owned and operated by the State. This 325-acre lake was constructed for water supply and recreation, but does provide a limited amount of flood storage. The locations of these improvements are shown in Figure V.

Nonstructural Measures

Nonstructural flood control measures are complete or partial alternatives to traditional structural measures. They include modifications in public policy, management practices, regulatory policy and pricing. In some cases, nonstructural means may be combined with fewer or smaller traditional structural measures to produce a plan. The major types are flood warning, floodplain zoning, flood insurance, flood proofing, and floodplain evacuation. These measures are primarily applicable to urban areas. Although urban flood damages are small in the subbasin, both Kittson and Roseau counties participate in the Federal flood insurance program. In addition, Roseau County has a floodplain zoning ordinance and building codes and subdivision regulations for floodplain areas. The town of Hallock participates in the flood insurance program and has a floodplain zoning ordinance and subdivision regulations for floodplain areas.

Hallock and the other towns in the subbasin participate in the Red River Valley flood warning system. The flood warning system for the Red River Valley is a cooperative network organized by the National Weather



Source: Gulf South Research Institute.

Figure V. EXISTING FLOOD CONTROL MEASURES

Service in Fargo, North Dakota. Fifty volunteers throughout the basin report to the National Weather Service on a weekly basis during winter and fall and on a daily basis during spring and summer. The reportage covers all precipitation of 0.1 inch or more, including amounts of snow and water equivalent. This information is transmitted to the River Forecast Center in Minneapolis, where it is run through a computer system to determine probable flood stages. The predictions are then transmitted to the National Weather Service in Fargo, which releases them to the public through the news media. Communities are then able to engage in emergency actions to protect themselves from flood damages. Contacts with local officials indicated that the flood warning system generally works quite well in the subbasin.

Farmers are eligible to participate in the Farmers Home Administration Crop Insurance Program. There are other types of measures that could be implemented in the subbasin to reduce flood damages but that are not directly applicable to urban areas. These measures would include such things as land treatment programs, use of present drainage ditches for floodwater storage, and use of natural areas for reversion to water retention use. Land treatment measures have been implemented in the watersheds of the Middle Fork and North Branch of Two Rivers. The measures, which were approved for implementation in the early 1960's, were planned and applied farm-by-farm within the two watersheds, consistent with the estimates of needs and the anticipated accomplishments that the sponsoring organizations felt could be done during the installation period. The types of land treatment measures that can be applied include such things as cover and green manure cropping, wind strip cropping, stubble mulching, pasture planting, field windbreaks, wildlife habitat development, wildlife habitat preservation, wildlife wetland development, farm ponds (dugouts), and grassed waterways.

Adequacy of Existing Measures

Public and private ditches and drainage systems are adequate for minor floods only. They can not handle large flood flows, and the subbasin sustains substantial damage during major floods. The improved channel constructed on Middle Fork (10.6 miles) was designed to contain the four percent (25-year) flood and is functioning satisfactorily. The improved

channel on the North Branch (11.5 miles) was designed to contain the 10 percent (10-year) flood and also is functioning satisfactorily. Channels of the three major streams in the subbasin--the North Branch, Middle Branch and South Branch--generally are adequate for the 30 percent flood and in some reaches are adequate for floods up to 10 percent frequency. The capacity of these streams could be increased to contain the 10 percent flood by clearing and snagging with some channel enlargement.

Although existing improved drainage systems function satisfactorily for minor floods, they are not extensive enough nor adequate for larger floods. Recurring flooding is still a problem throughout the subbasin. Additional flood control measures are needed to reduce annual flood damages in the Two Rivers Subbasin.

VII. CRITERIA AND PLANNING OBJECTIVES

VII. CRITERIA AND PLANNING OBJECTIVES

Floodplain Management Criteria

Technical, economic, and environmental criteria must be considered when formulating and evaluating alternative floodplain management measures for the subbasin.

The technical criteria used in formulating and evaluating alternatives for this report consisted of the application of appropriate Federal engineering standards, regulations, and guidelines.

Economic criteria entailed the identification and comparison of benefits and costs of each measure. Tangible economic benefits or appropriate gains in environmental quality must exceed overall costs; however, in certain instances, considerations of appropriate gains in the other accounts (environmental quality, social well-being and regional development) could alter this requirement. All alternatives considered are scaled to a design which optimizes benefits. Annual costs and benefits are based on an interest rate of 7 1/8 percent and price levels and conditions existing in October 1979. A 50-year amortization schedule is used for the features considered.

Environmental considerations call for the formulation of measures that minimize objectionable or adverse environmental effects and maximize environmental benefits. Also, limited consideration was given to modifications based on coordination with state and Federal agencies, local interests, and citizen groups.

Planning Objectives

The primary planning objective of this study was to contribute to flood reduction needs in the subbasin and thereby provide protection from or reduction of flood losses. In conjunction with this economic objective, the study attempted to develop contributions to the environmental quality of the subbasin.

The development of planning objectives involved a broad-range analysis of the needs, opportunities, concerns, and constraints of the subbasin. From the information available concerning identifiable problems, needs, and desires, the following planning objectives were established:

1. Contribute to protection from and prevention, reduction, or compensation of flood losses for the flood prone areas of the subbasin during the period of analysis.
2. Contribute, to the maximum extent possible, to the preservation of the quality of the existing riverine environment and enhance the environmental potential of the subbasin as a whole.
3. Contribute to the enhancement of recreational opportunities by improving water quality in Two Rivers, by protecting the remaining woodlands and wetlands, and by curtailing clearing and draining practices.
4. Contribute to the improvement of water quality in Two Rivers.
5. Contribute to the improvement of water supply in the western portion of the subbasin.
6. Contribute to the reduction of wind and water erosion throughout the subbasin.
7. Contribute to the developing trend toward increased irrigation throughout the subbasin by investigating the surficial sand aquifers.
8. Contribute the reduction of wastewater management problems, particularly insofar as they relate to water quality.

VIII. FORMULATION OF ALTERNATIVE MEASURES

VIII. FORMULATION OF ALTERNATIVE MEASURES

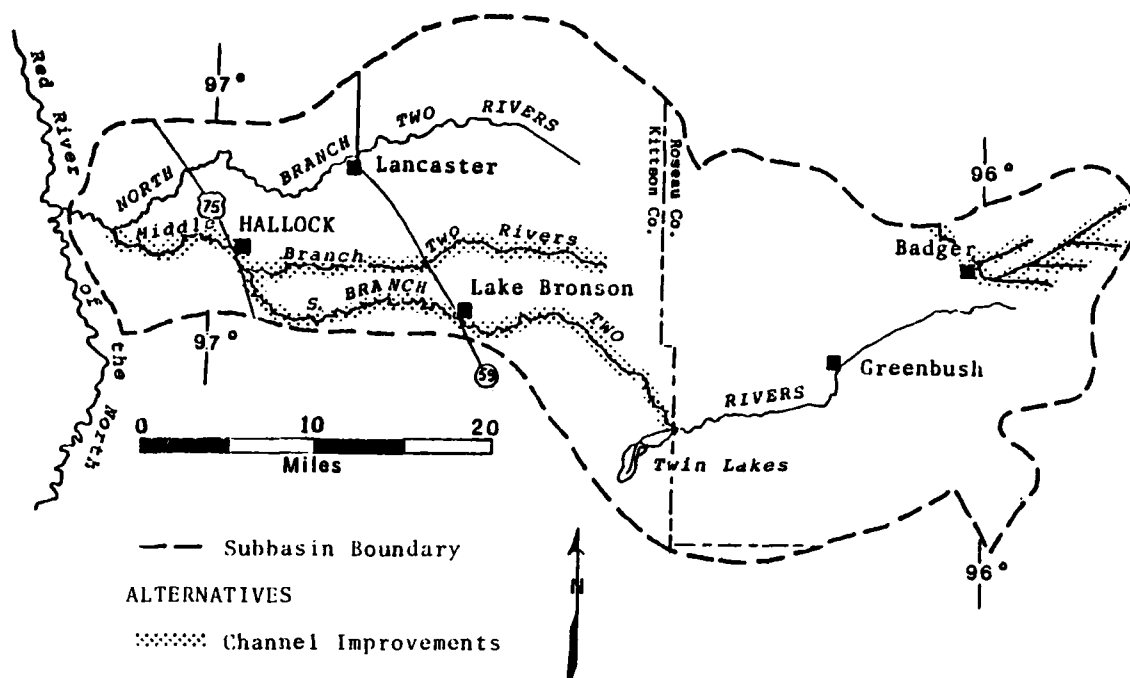
This section contains a discussion of management measures that have been identified to meet the resource management objectives. In the formulation of measures, prime consideration was given to the resolution of flooding problems. Measures to satisfy the other planning objectives were considered exclusively as components of the flood control measures.

The following measures, which are shown on Figure VI, were devised in response to the flood control objective:

1. Clearing, snagging and some channel enlargement along 86 miles of Middle Branch and South Branch to contain the 10 percent flood. This alternative includes 25 miles of clearing and snagging in the Middle Fork channel and 61 miles of clearing and snagging in combination with 10 miles of channel enlargement in the South Branch channel. This measure would protect 27,500 acres and the towns of Hallock and Lake Bronson from a 10 percent flood. The implementing agency for this project would be the Corps of Engineers.
2. Badger-Skunk Creek Watershed project. The primary objective of this project is to accomplish a water management program that will afford reasonable protection from flood damage and provide a system of major outlet channels for farm drainage. A complete program of watershed treatment would control erosion, reduce runoff, and eliminate much damage to farmland, roads, and bridges. Structural methods include the reconstruction of 20 miles of existing channels, the construction of 12 miles of new channels, and possibly two stabilization structures. Other features include land treatment measures and the construction and repair of numerous drainage ditches. This project, which would provide 10 percent flood protection for the watershed, has been approved for planning, but no priority has been assigned.
3. Construction of levees around individual farmsteads in the one percent floodplain. These levees would protect individual farmsteads against the one percent flood and could be constructed by the SCS, the Corps of Engineers, or private interests.

Engineering Methodology

The channel clearing, snagging, and enlargement measure was analyzed on the basis of the effects of the ten and one percent floods occurring



Source: Gulf South Research Institute.

Figure VI. ALTERNATIVE FLOOD CONTROL MEASURES

in the subbasin independently of flooding caused by Red River of the North backwater and/or overland flooding from other subbasins. In order to develop the flood damage reduction measures and resulting benefits, flood frequency versus discharge curves for various points in the subbasin were developed from information obtained from prior reports and historic stream hydrological data compiled by the Corps of Engineers. Data from these curves were used to plot drainage area versus discharge curves for the entire subbasin for one, 10, and 30 percent floods. From these curves and generalized stream discharge versus area flooded curves developed during the course of this study, the total area flooded for various stream discharges was determined. These data were used to develop area flooded versus chance of exceedence in one year for the present condition and the 10 percent flood, which was used to estimate average annual damages and benefits for the channel improvement measure. In estimating annual benefits and damages, the effect of woodlands has been taken into account.

The Badger-Skunk Creek Watershed measure was developed from information contained in prior studies and reports and from cost data developed by the contractor during the course of this study. The farmstead levee measure was analyzed on the basis of provision of one percent flood protection and under the assumption that the levees would be constructed by individual owners.

There is very little stream flow and hydrological data available for the subbasin. The analysis of flood damage reduction measures and resulting benefits, damages, and capital costs was based on this limited data, generalized data developed from other subbasins, and the contractor's experience and judgement.

Nonstructural Measures

Besides nonstructural measures already in place in the Middle and North Branch Watersheds of the Two rivers Subbasin, the Badger-Skunk Creek Watershed has applied for assistance in developing land treatment measures. This was mentioned in connection with the second structural alternative described above.

Potentials for water retention in existing ditches should be considered. Natural retention areas should also be considered for preservation. However, these would need to be identified, and their retention capacities would need to be determined. There may also be opportunities for wetland restoration. In addition, floodplain regulation should be implemented at Lake Bronson, even if this alternative would not significantly reduce flood damages in the subbasin.

IX. ASSESSMENT OF ALTERNATIVES

IX. ASSESSMENT OF ALTERNATIVES

Economic Assessment

The terrain in the subbasin is very flat and poorly drained. Recurrent flooding of agricultural lands adjacent to the three branches (North, Middle, and South) is the most serious problem in the subbasin. Existing river channels provide inadequate outlets for the extensive tributary ditch systems, which results in backwater flooding at the downstream ends of these ditches. In addition, flood problems are aggravated by overflow floodwaters from the Roseau River entering the tributary ditches from the Big Swamp area.

For the economic evaluation of the measures that were devised to solve these problems, average annual benefits were derived by either updating average annual benefits from prior reports to October 1979 levels or else by applying updated weighted damage per acre figures from the draft Section 205 Detailed Project Report for Flood Control, Snake River below Warren, Minnesota, which was completed by the St. Paul District Corps of Engineers in 1979.

The economic evaluation of the three proposed flood control alternatives is presented in Table 12. Alternative 1 involved clearing, snagging, and some channel improvements along 86 miles of the Middle Fork and South Branch to contain the 10 percent frequency flood. This measure would protect 27,500 acres and the towns of Hallock and Lake Bronson. Total average annual benefits of \$185,100 divided by average annual costs of \$160,000 yielded a benefit/cost ratio of 1.16. As a point of interest, average annual rural benefits alone would have yielded a favorable benefit/cost ratio. Alternative 2 involved an overall water management plan and included channel construction and reconstruction, two stabilization structures, and land treatment measures. Economic analyses of this alternative produced an unfavorable benefit/cost ratio of 0.79. The third alternative was farmstead levees. These levees would encircle individual farmsteads in flood-prone areas and provide protection against one percent frequency floods. Economic analyses of the alternative assumed implementation by private individuals and yielded a benefit/cost ratio of 2.10.

Table 12
ECONOMIC EVALUATION OF ALTERNATIVES, TWO RIVERS SUBBASIN

Alternatives	Acres Protected	Average Annual Acres	Capital Costs	Average Annual Costs	Average Annual Rural Benefits	Average Annual Urban Benefits	Total Average Annual Benefits	B/C Ratio
1. Channel Improvements to Middle Fork and South Branch (10 percent flood)	27,500	2,828	\$2,161,000	\$159,100	\$169,000	\$16,100	\$185,100	1.16
2. Channel Improvements, Stabilization Structures(2) and Land Treatment Programs (10 percent flood)	84,500	--	2,137,000	157,000	123,600	--	123,600	0.79
3. Farmstead Levees (per levee)	--	--	5,600	400	840	--	840	2.10

Source: Gulf South Research Institute.

Impact Assessment

Table 13 provides a general assessment of anticipated effects on the key resource elements of the study area resulting from each of the three alternative measures being considered. The rationale developed for the ratings assigned each measure is presented below.

Channel Improvements

Channel improvements would yield moderately beneficial social and economic effects, some moderate to maximally adverse biological effects, and short-term adverse but long-term limited beneficial results for water quality elements. No effects are known to take place with respect to water supply and cultural elements, while minimally positive recreation benefits would result from such actions.

Social and economic benefits would accrue from the flood protection and flooding reductions that would stem from the project. Some 28,000 to 85,000 acres in the subbasin would be afforded such protection, depending on the alternative selected. Possible oxbow lakes and trails for summer and winter use would yield recreational benefits. Biological and water quality elements would be affected negatively by dredging activities, placement of dredged material, vegetation removal, and temporary turbidity. Water quality should, however, improve in the long run as stream flows are enhanced.

Notably adverse effects would stem from channel improvements on the Middle and South branches, where the woodland corridors along these reaches provide valuable habitat for terrestrial vertebrates and the remaining wetland areas are of large environmental value.

Farmstead Levees

Localized minimally beneficial economic and social effects would result from the protection of farmsteads from frequent floods by development of ring levees. Other resource elements would not be notably affected, although aesthetic, sanitary, and maintenance factors would need to be considered.

Table 13
ASSESSMENT OF MEASURES, BY RESOURCE ELEMENT, TWO RIVERS SUBBASIN

Measures	Social	Economics	Land Use	Biology	Water Quality	Water Supply	Cultural	Recreation
1. Channel Improvements-Middle Fork and South Branch (10% flood)	MoB	MoB	NKE	MaA	MiA/B	NKE	NKE	MiB
2. Channel Improvements, Stabilization Structures (2) and Land Treatment Programs (10% flood)	MoB	MaB	NKE	MoA	MiA/B	NKE	NKE	MiB
3. Farmstead Levees	MiB	MiB	NKE	NKE	NKE	NKE	NKE	NKE

Note: NKE = No Known Effect
 MiA = Minimally Adverse
 MoA = Moderately Adverse
 MaA = Maximally Adverse
 MiB = Minimally Beneficial
 MoB = Moderately Beneficial
 MaB = Maximally Beneficial

Source: Gulf South Research Institute.

X. EVALUATION

X. EVALUATION

Two alternative measures presented for the subbasin have benefit/cost ratios that exceed unity. They are the channel improvements to the Middle Fork and South Branch of Two Rivers and the farmstead levees.

The channel improvements would have favorable social well-being effects, and benefits stemming from urban and rural protection would slightly exceed costs. This alternative measure appears to maximize net economic benefits for the subbasin, but only protect some 28,000 acres. Other proposed channel improvement measures, although having benefit/cost ratios less than one, afford more protection; but the increment in benefits does not exceed the additional cost of such measures.

The farmstead ring levees also exceed the above unity criteria but do not notably benefit the resolution of subbasin flooding problems. Greatest environmental enhancement would result from the land treatment programs associated with protecting some 84,500 acres, even though these programs would accompany one of the channel improvement measures with benefit/cost ratios of under one.

National Economic Development (NED) and Environmental Quality (EQ) plans will be tentatively formulated in association with the Red River of the North Basin's main reconnaissance report.

XI. ADDITIONAL STUDY NEEDS

XI. ADDITIONAL STUDY NEEDS

This report was developed almost entirely on the basis of secondary information from readily available planning documents. Data available from state and Federal agencies was not fully canvassed, and only a limited number of calls were made to the area. In particular, state university libraries and department resources could not be fully utilized. Thus, the document aims only at a broad-brush perspective. In order to provide a more detailed and in-depth analysis of subbasin resources, problems, and potential solutions, the following additional study needs would have to be fulfilled:

1. A literature search should be conducted to obtain available biological data for the subbasin. Fieldwork should be planned to fill in any data gaps which exist with the end result of obtaining good baseline data for the subbasin. This is particularly necessary in those areas where flood control measures have been proposed.
2. Areas of high environmental quality (e.g., prairie remnants) should be identified and inventoried within the subbasin.
3. Knowledge of the location, areal extent, and types of wetlands occurring within the specific subbasin boundaries would be extremely useful in determining whether wetland restoration would assist in alleviating flood problems, as has been indicated by Cernohous (1979).
4. Primary water and sediment quality data are needed to characterize baseline conditions in the streams of the subbasin, particularly in those areas where channelization has been proposed.
5. Information pertaining to wastewater management needs to be updated.
6. The information obtained in items 1-5 above would provide an important data base upon which an impact evaluation of proposed flood control measures can be performed and would provide information relative to the cumulative effects of flood control projects on environmental resources in the subbasin. These projects include those that are in place or proposed.
7. Nonstructural flood damage reduction measures should be thoroughly explored such as those listed below.

- . Establishment of buffer areas and curtailment of inappropriate residential, commercial, and other development in floodplains.
 - . Maintenance and enhancement of existing riparian vegetation along the three branches of Two Rivers and tributaries to conserve and restore wildlife habitats, help control wind and streambank erosion, retain soil on the land, and to reduce the amount of sediment, nutrients, and other pollutants entering waterways.
 - . Maintenance of grassed waterways to reduce erosion.
 - . Establishment of vegetation in areas of critical erosion.
 - . Determination of the feasibility of installing water control structures at existing culverts to retain water in drainage ditches for longer periods of time during critical runoff periods to minimize flooding in downstream areas.
 - . Determination of the feasibility of utilizing "on-farm storage" to control runoff through such means as natural storage areas and control structures on existing culverts.
 - . Prevention of overgrazing on grasslands and utilization of sound agricultural land use practices.
 - . Provision for strict enforcement of floodplain management programs within the subbasin.
8. The potentiality for land treatment measures (e.g., erosion control measures such as cover crops, green belts, reduction in fall tillage, etc.) needs to be thoroughly investigated.
 9. The people of the subbasin need to be included in further water resource planning efforts. A public involvement program would provide more complete information on water resource problems and opportunities than is presently available.
 10. Studies are needed to determine additional demand for recreational facilities, usage of existing facilities, and potential sites.
 11. A review of secondary sources and systematic field reconnaissance is needed to identify archaeological and historical sites and to determine their eligibility for nomination to the National Register of Historic Places.
 12. A detailed social profile of the subbasin is needed.
 13. A detailed institutional analysis of the subbasin is needed.

14. Subbasin boundaries need to be better defined on the basis of hydrologic conditions, and total acreage in the subbasin needs to be precisely measured.
15. An adequate 100-year floodplain map needs to be developed. Also, the extent of floodplains for smaller frequency storms needs to be delineated.
16. Land use within the floodplain needs to be precisely identified.
17. The irrigation potentials of the subbasin soils need to be investigated.
18. The effect of drainage works on flood discharges and stages is unknown at present. It would take additional, more detailed studies to determine the extent and effect of reduced natural storage.
19. Potentialities for floodwater storage in present drainage ditches need to be investigated.
20. Crop distribution in the floodplain needs to be precisely identified through contact with county agents, and average annual rural damages need to be updated.
21. Urban damages need to be recomputed in a systematic fashion.
22. Whether forested acreages in the floodplain are increasing or declining needs to be precisely determined.
23. More study is needed to determine the precise nature of the water supply problems and potential solutions.
24. More gauging stations need to be developed to provide hydrologic data for establishing flood frequencies and rating curves.
25. Channel cross-sections of the various streams need to be prepared for flood control planning purposes.

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Appendix A
FLOODPLAIN DELINEATION

Appendix A

FLOODPLAIN DELINEATION

Prior to this study, no attempt was made to publish even a generalized delineation of the entire Two Rivers floodplain. In undertaking this task, the present study utilized all known sources to provide the best available data for generalized delineation at a scale of 1:250,000. Principal sources were: USGS Flood Prone Area Maps (scale 1:24,000), Federal Insurance Administration flood maps (various scales), published secondary sources, U. S. Geological Survey (USGS) 7½ minute topographic maps, and other sources, including derived data where necessary.

The Flood Prone Area Maps published by the USGS provided detailed and accurate information for the area mapped. However, only two sheets--one in the extreme eastern and one in the extreme western end of the subbasin--were available.

Federal Insurance Administration Flood Hazard Boundary Maps and Flood Insurance Rate Maps provide important coverage of the Minnesota portion of the Red River Basin. The former are designed only to delineate the 100-year floodplain. The latter are much more detailed and usually more accurate. The subbasin is comprised almost equally of parts of Kittson and Roseau counties, with a very minor portion in Marshall County for which no flood insurance map is available. Kittson County has a Boundary Map, and Roseau has the more detailed Rate Map. The latter indicated that the marsh flood zone area was approximately 60 percent of the total area indicated as marsh on topographic maps. This percentage was applied to adjacent Kittson County marshlands to arrive at comparable delineations in the central part of the subbasin.

Secondary sources, such as the Souris-Red-Rainy River Basins Type II Study (delineating the main stem floodplain) were also utilized. Published floodplain descriptions and acreage estimates in the Soil Conservation Service (SCS) Middle Fork and North Branch of Two Rivers Watershed Work Plans, the Two Rivers Watershed District Overall Plan, and other sources were consulted. Eight 7½ minute and two 15 minute USGS topographic maps (mostly for the central and southeastern part of the subbasin) were also consulted.

Where published information was lacking, as in the middle and upper reaches, the extent of the floodplain was inferred from gallery forests along old meander channels and marsh patterns indicated on the USGS 250,000-scale maps. Obvious differences between flood insurance maps from Roseau and Kittson counties were also resolved by inferring the more detailed delineation across the county line. As noted earlier, data from the above sources was compiled and delineated on USGS 250,000-scale maps. The floodplain indicated was then planimetered, with figures in square inches converted to acres and rounded to the nearest 2,000.

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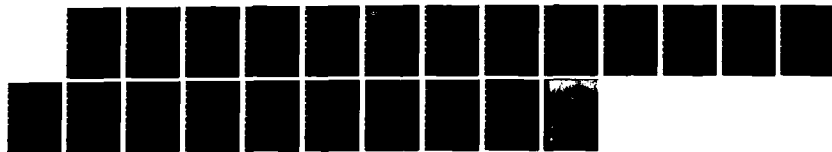
RED RIVER OF THE NORTH RECONNAISSANCE REPORT: TWO
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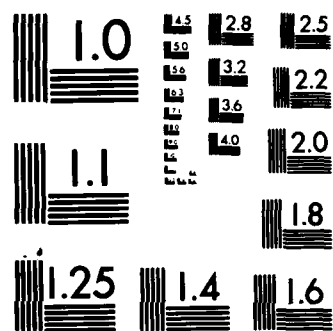
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Appendix B

INVENTORY OF OUTDOOR RECREATIONAL
FACILITIES, TWO RIVERS SUBBASIN

Appendix B

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES (WILDLIFE MANAGEMENT AREAS) TWO RIVERS SUBBASIN

<u>Number</u>	<u>Name</u>	<u>Location</u>	<u>Boundary Acres</u>	<u>WMA Managed Acres</u>	<u>Date</u> ¹
1	Caribou WMA	Kittson Co. 16346W00 Lancaster	19,214.4	4,353.0	71
2	Skull WMA	Kittson Co. 16347W14 Lancaster	6,480.0		76
3	Castor WMA	Roseau Co. 16144W05 Leo	841.7		76
4	Beaches WMA	Kittson Co. 16245W00 Lake Bronson	40,126.0	734.0	71
5	Twin Lakes WMA	Kittson Co. 16045W36 Twin Lakes	8,099.8	7,600.0	71
Total Acres:			74,761.9	19,687.0	

¹Date of latest information.

Source: Minnesota Department of Natural Resources, Division of Parks and Recreation.

Appendix C
COMMENTS

Appendix C
COMMENTS

The purpose of this subbasin report was to provide an overview of the water and related resource problems and needs and to assess potential solutions. Toward this end, draft copies of this report were circulated to Federal, State, and local agencies and comments were sought.

This review resulted in complete and factual documentation. Thus, the study should serve as a building block for the timely completion of future water resource efforts within the subbasin. Further cooperative efforts are, however, needed to evaluate these tentative results and to develop potential solutions.

A distribution list and copies of the comments made with respect to the draft report are included as part of this appendix. Comments that resulted in specific modifications to the draft text are marked by an asterisk.



DEPARTMENT OF THE ARMY
ST PAUL DISTRICT CORPS OF ENGINEERS
1135 U S POST OFFICE & CUSTOM HOUSE
ST PAUL, MINNESOTA 55101

REPLY TO
ATTENTION OF:

NCSED-PB

25 July 1980

Mr. Mike Liffmann
Project Manager
Gulf South Research Institute
8000 GSRI Avenue
Baton Rouge, Louisiana 70808

Dear Mr. Liffmann:

The draft Two Rivers subbasin report was distributed for review and comment. Most of the reviewers have sent their comments to us.

- a. Inclosure 1 includes letters from various Federal and State agencies.
- b. Inclosure 2 is the general office comments that need to be considered when preparing the final Two Rivers subbasin report and the remaining subbasin reports or the overall document.
- c. Inclosure 3 identified specific office concerns that are applicable to the Two Rivers subbasin report.

If you have any questions on our comments or proposed modifications, please contact us.

Sincerely,

3 Incl
As stated

for Louis E. Kowalski
LOUIS E. KOWALSKI
Chief, Planning Branch
Engineering Division



United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

St. Paul Field Office, Ecological Services
538 Federal Building and U.S. Court House
316 North Robert Street
St. Paul, Minnesota 55101

July 14, 1980

Colonel William W. Badger
District Engineer, St. Paul District
U.S. Army Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Colonel Badger:

This provides U.S. Fish and Wildlife Service comments on the Draft Reconnaissance Report recently compiled by Gulf South Research Institute for the Two Rivers Subbasin in Kittson and Roseau Counties, Minnesota.

As expressed in our comments on previous Subbasin Reports, our concerns are associated with the woodland, grassland, wetland, riverine, and riparian floodplain habitats that remain within the Two Rivers Subbasin. Much of the grassland, woodland, and wetland habitat in the western part of the Subbasin have been converted to agricultural uses. Remaining woodland habitat in the western portion is primarily confined to the floodplain of the North, South, and Middle Branches of Two Rivers. We agree with the statements on pages 12 and 36 of the Report that these woodland areas are significant and need to be protected because of their high wildlife value. Most of the remaining wetlands are located in the central and eastern portion of the Subbasin and we also agree with the statements on page 12 and 13 that these wetland areas need to be protected from further drainage and conserved and enhanced.

The Report addressed three structural alternative measures that have been considered to date to reduce the flooding problems within the Subbasin. Our comments relative to these various structural measures (channel improvements and farmstead levees) are similar to those expressed on previous Subbasin Reports. We are especially concerned with Alternative 2 (Badger - Spunk Creek Watershed Project) which would involve the construction of major outlet channels and numerous drainage ditches to facilitate farm drainage in the extreme eastern portion of the Subbasin. The Report indicated, however, that this alternative had an unfavorable

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benefit/cost ratio (0.79) and, as such, would not justify its implementation. The channel improvements being considered for the Middle and South Branches of Two Rivers would also create significant adverse impacts on fish and wildlife resources as a result of the dredging activities, vegetation removal, and placement of dredged material associated with this project.

We believe a plan involving a combination of structural and nonstructural measures (as provided on page 4 of our May 8, 1980 letter on the Draft Reconnaissance Report for the Tamarac River Subbasin) should be implemented. Some of these nonstructural measures are addressed on page 64 of the Report and we agree with the statement on page 63 that these flood reduction measures should be thoroughly explored, and implemented to the maximum extent possible, within the Two Rivers Subbasin. We also agree that the additional studies identified on pages 63-65 of the Report (particularly numbers 2, 3, 7, 8, 18, 19 and 22) need to be undertaken to provide a more detailed and in-depth analysis of existing Subbasin problems and the potential solutions to many of these problems.

In addition, we suggest that the following changes be made in the Final Report:

- * 1. Page 34, Figure IV - put a square, triangle, or circle around the numbers in the legend under Existing Wildlife Areas, Existing Recreation Areas, and Other Recreation Areas so these areas can be identified by the corresponding numbers and symbols on the map.
- * 2. Page 37, 3rd sentence under the heading Wetlands - change this sentence to read as follows:

No wetland surveys were undertaken by the U.S. Fish and Wildlife Service of Kittson and Roseau Counties in 1964 or 1974.
- * 3. Page 38, paragraph under the heading Waterfowl Production Areas - delete this paragraph which is unnecessary and simply put the following sentence under this heading:

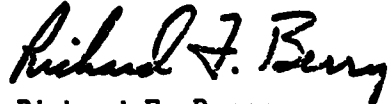
No federal waterfowl production areas (fee or easement) have been acquired to date by the U.S. Fish and Wildlife Service within the Two Rivers Subbasin.
- * 4. Page 50, 1st paragraph, last sentence - we suggest this sentence end after grassed waterways and "drainage mains or laterals and drainage field ditches" be deleted from this paragraph.

Land treatment measures undertaken should be those types which will retain the soil and water on the land - not facilitate the drainage of wetlands or contribute to increased flood flows and flood damages in downstream areas of the Subbasin.

- *5. Page 60, 1st sentence under the heading Impact Assessment
- change the word seven to three as only three primary alternatives are addressed in the Report (See pages 54, 58, 59 and 61).
- *6. Page 61, Table 13 - these three alternative measures should be numbered as was done in Table 12 on page 59 of the Report.

These comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et. seq.) and are consistent with the intent of the National Environmental Policy Act of 1969.

Sincerely,


Richard F. Berry
Field Office Supervisor

cc: Minn. DNR, St. Paul
S. Bittner, Gulf South Res. Inst.

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

316 North Robert Street, St. Paul, Minnesota 55101

June 20, 1980

Colonel William W. Badger
District Engineer
U. S. Army Corps of Engineers
1135 U. S. Post Office & Custom House
St. Paul, MN 55101

Attention: NCSED-PB

Dear Colonel Badger:

The Soil Conservation Service has reviewed the draft reports for the Roseau River and Two Rivers Subbasins, prepared by GSRI. The following comments are offered for your consideration:

Roseau River Subbasin

1. Page 9, 1st paragraph - Do the figures given in the last sentence refer to wetland acreage or flood plain acreage?
2. Page 10 - Insert "million" after \$21.7 on the last line of the page.
3. Page 11, last full sentence on page - Page 22 and this sentence indicate that 37.9% of the land is cultivated. What does the 50.5% figure refer to?
4. Page 59, 2nd paragraph, item (2) - Suggest rewording as follows, "...existing lateral ditch system as identified in the Duxby Watershed application for PL-566 assistance, to be constructed by others; and..."
5. Page 64, 2nd paragraph, item (3) - Suggest rewording as follows, "(3) improvements to the existing lateral ditch systems as identified in the Duxby Watershed application for PL-566 assistance; and ..."
6. Pages 70 and 71, item 4 - Maintenance of grassed waterways, establishment of vegetation, prevention of overgrazing do not need additional study. These are items that need to be carried out. This would apply to item 5 also.



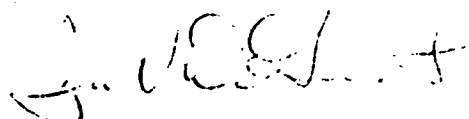
7. Page 71, item 6 - Suggest this be deleted. It is not likely that farmsteads would be built in wetlands. Also, this would be determined on a case by case basis as plans are developed.

Two Rivers Subbasin

1. Page 12 - The last paragraph mentions the Joe River. Since this is the first mention of this tributary, it should be identified as to its location, size, etc.
2. Page 54 - The Badger-Skunk Creek Subwatershed should be located on the map on page 55.

Thank you for the opportunity to review these draft documents.

Sincerely,



Jon V. DeGroot
Asst. State Conservationist

U.S. Army Corps of Engineers
North Central Division
Comments on the
Draft Two Rivers Subbasin Report
June 1980

<u>Cmt. No.</u>	<u>Comment</u>
1.	Page 13. Recreation Problems. In addition to the available recreation resources, the report should indicate the current demand (SCORP) and projected demand for recreation in the study area. This information is necessary to accurately represent the recreation problems in the study area.
2.	In the final reconnaissance report more definite data (quantitative) should be furnished on the future demand for water supply, recreation, etc.
*3.	Page 48. Revise the definition of nonstructural plan to that contained in the latest revision of the P & S. The definition contained in the report may not be accurate for all examples of nonstructural projects.
*4.	Page 48. Under nonstructural programs, indicate current and projected eligibility and participation in Farmers Home Administration Crop Insurance Program.
5.	Page 7. If the 3.5-percent figure cannot be backed up, it should be excluded.
6.	Page 56. Future studies must consider the coincidence of flooding due to the Red River proper. This will probably reduce the benefits computed due to channel modifications.
7.	The impact of floodplain valley storage loss on flooding through channel modifications or levee work needs to be analyzed in future studies.
8.	If further studies are warranted for this subbasin and identified as such in the overall Red River of the North Reconnaissance Report, specific objectives should identify the need to contribute to the protection and enhancement of prairie lands, cultural resources, recreational opportunities and threatened or endangered species.

Cmt.

No.Comment

9. Figure II is a poor map cartographically. There needs to be a legend which clearly describes the patterning used to delineate the 100-year floodplain, marshy areas, etc.
10. Would suggest modifying the explanation of nonstructural measures. Would suggest incorporating the following thoughts.
- Nonstructural measures modify the susceptibility of land, people, and property to damage or losses. In addition they modify the impact of flooding upon people and communities. Nonstructural measures do not attempt to modify the behavior of floodwaters.
11. Add a discussion of the National Objectives (NED & EQ) as established by P & S.
12. The list of objectives is basically good but awkwardly written. Would suggest rewriting such as below.
- Enhance the recreational opportunities in the Two Rivers Subbasin for the benefit of the local people.
13. The assessment and evaluation sections need to emphasize how each alternative meets or doesn't meet each objective -- both study objectives and National Objectives.
14. Holding a public meeting in the 1960's does not necessarily mean that either the Corps has good understanding of the local needs or the public correctly perceives the Corps' activities. Attitudes change over time, a 10 year time span is too long for ideas to maintain any continuity.

STATE OF
MINNESOTA

DEPARTMENT OF NATURAL RESOURCES

444 Lafayette Road, Space Center Bldg., St. Paul, MN 55101

PHONE 612/296-4800

File No _____

July 10, 1980

Colonel William W. Badger
St. Paul District Engineer
Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, MN 55101

Dear Colonel Badger:

COMMENTS ON ROSEAU AND TWO RIVERS SUBBASIN REPORTS

The Department of Natural Resources, Division of Waters, has reviewed the above referenced documents. Both documents provide a good overview of the flooding problems and some of the other problems and needs in the basins.

During the review process several problems were identified. On page 56 of the Two Rivers Subbasin Report the discussion of the channel improvements measure states that the backwater effects of the Red River and the cross-over flow from the Roseau Subbasin were not considered in the development of costs and benefits for the alternative. Since these are both significant effects in the Two Rivers Subbasin it would seem to be necessary to evaluate both of these factors before the construction costs and the level of protection provided by the measure could be determined. If this same procedure was used in the evaluation of channel improvements in other subbasins, these measures should be checked again to determine whether or not the benefits and costs assigned to the channel improvement measures are still valid.

We note with interest that on page 64 of the Roseau River Subbasin Report, it states that the updated benefit cost ratio of the authorized project on the Roseau River is now .89. Does this updated figure assume a higher interest rate than was used for project authorization or have costs actually risen enough to reduce the B/C ratio from 1.25 to .89 ? What are the implications for project implementation ?

My last comment is with regard to the additional study needs on pages 70-72. It is quite surprising to see all of the data deficiencies listed for the Roseau River Subbasin. One would intuitively suspect that this subbasin would have a greater quantity of high quality data because of all the planning that has been done for the authorized project on the Roseau River.

While it seems probable that the authorized project on the Roseau River will be constructed, it does not appear as though most other subbasins will be similarly protected. Because of the apparent lack of feasible federal projects, and the general lack of data, it seems that the Corps could best direct it's

Colonel William W. Badger

Page 2

July 10, 1980

future efforts to the collection of hydrologic and hydraulic data; damage data; and data on storage potential in small reservoirs, drainage ditches and wetlands as well as an overall modelling effort. The provision of data such as this might allow state and local governments and individuals to begin to identify appropriate measures for localized protection in cases where no substantial federal interest is apparent.

Thank you for the opportunity to comment on these documents. If you have any further questions, please contact Joe Gibson at 296-0438 or Ron Harnack at 296-0440.

Sincerely,

DIVISION OF WATERS



Larry Seymour
Director

LS/JG:ph

cc: Joe Gibson
Ron Harnack
Gerry Paul
Roseau River Watershed District

GENERAL COMMENTS
DRAFT TWO RIVERS SUBBASIN REPORT
(JUNE 1980)

(These comments apply to the entire report and all subsequent subbasin documents.)

1. This document generally needs additional detailed information concerning non-structural alternatives. Few of the structural alternatives appear feasible; therefore, unless economics are ignored, nonstructural solutions remain important to reduce the magnitude of future flood damages. The overall report should address and clarify this aspect of flood damage reduction planning.

2. Comments from Federal, State, and local agencies and a letter (with comments) from the St. Paul District will be included in an appendix in each final subbasin and in the overall report. The format for the appendix will be:

a. Introduction - This section should stress:

- (1) The importance of completing the study on time.
- (2) That the purpose of the study is to advise other agencies and interests.
- (3) The need for a selected review by various interests to provide complete and factual documentation.
- (4) The use of the study as a building block for future water resource efforts.
- (5) That cooperative efforts to evaluate results and develop solutions to remaining problems will be incorporated.
- (6) A complete public involvement program when the study is finished.

b. The distribution list.

c. Copies of letters of comment.

Only comments that identify significant errors or need specific attention will be addressed in the final subbasin report. However, all comments incorporated should be identified with a marking system. The distribution list for the Two Rivers subbasin report is given below:

<u>Agencies receiving draft report</u>	<u>Date sent</u>	<u>Date comments received</u>
Federal		
Soil Conservation Service	17 Jun 80	20 Jun 80
Fish and Wildlife Service	17 Jun 80	14 Jul 80
Corps of Engineers, North Central Div.	17 Jun 80	-
Corps of Engineers, St. Paul District	17 Jun 80	27 Jun 80

State

Water Planning Board	17 Jun 80	-
Department of Natural Resources	17 Jun 80	7 Jul 80
Planning Agency	17 Jun 80	-
Water Resources Board	17 Jun 80	-

Local

Watershed District	17 Jun 80	-
Civil Defense Director	17 Jun 80	-
Northwest Regional Dev. Comm.	17 Jun 80	-

3. The source for most information identified in the majority of the tables is Gulf South Research Institute. If other sources were used, an appropriate reference should be made.

4. The evaluation section of each report in essence is the recommendations of the document. Generally only the alternatives (structural) which have a benefit-cost ratio greater than 1 are presented. Little attention is given to the other alternatives whether structural or nonstructural which may be important aspects of future flood damage reduction planning for either the subbasin or the overall basin as a whole. Some of these alternatives may provide the necessary environmental conditions to warrant future efforts. As a consequence, this section should be expanded to provide the appropriate discussions.

5. Rather than stating in each report and for each alternative evaluated that there will be no or negligible effects on cultural resources the report should indicate that it is not possible to identify effects on cultural resource until a systematic cultural resources survey has been completed in the subbasin. Such statements are misleading because it appears that there are no significant sites in the subbasin. In reality, there are simply no known sites and the document and tables should be modified, as appropriate.

6. The backup information for alternatives including technical, economic, and any environmental data should be provided (at least under separate cover). This would simplify matters when questions are asked during review or in the future.

7. The maps should have more detail. Often information in the text is not clearly illustrated on the maps. These maps would be improved if reproductions were better quality and included township lines or relationships of subbasin to counties or State lines.

SPECIFIC COMMENTS
DRAFT TWO RIVERS SUBBASIN REPORT
(JUNE 1980)

- *1. Page 2 - After the last sentence, add: "The main report will consider the possibility of various water resource-oriented agencies serving as vehicles for implementing flood damage reduction actions and undertaking additional study needs."
- *2. Page 2 - Number 6 should be added which discusses the Barr Engineering comprehensive water management study of a portion of the Two Rivers watershed. This study is being contracted to Barr Engineering by the State of Minnesota.
- 3. Page 4, Figure I - The map should be revised as follows:
 - a. Hallock should not be in all capital letters.
 - b. The word "Middle" should be moved to the right to agree with the discussion in the first paragraph on page 5. This discussion suggests that this part of the river is actually the main stem Two Rivers.
 - c. The Canadian border should be indicated.
- 4. Page 5, 1st line - Should the "13 miles" be identified as river miles? Page 3 says the northern edge of the subbasin boundary is within 2.5 miles of the U.S.-Canadian boundary and a roughly scaled distance indicates the mouth of the Two Rivers is about 25 miles from the boundary.
- * 5. Page 5, 2nd paragraph, 3rd sentence - After "...example," and before "overflow" add "occasionally." Also, similar changes, as necessary, should be made in other parts of the report to clarify this.
- * 6. Page 5, last sentence - The "Middle Fork" should be "Middle Branch." This comment also applies to pages 17, 47, 48, 51 and 54.
- * 7. Page 7, 2nd paragraph, 1st sentence - Change to read "...the branches of the Two Rivers do not..."
- * 8. Page 7, 3rd paragraph, 1st sentence - Flows from the branches often correlate with peak flows on the Red River because of the long duration of the Red River flood peak. This should be added.
- * 9. Page 7, 4th paragraph - It is not clear whether the 3.5-percent contribution of runoff is intended to be a volume or peak reference. This item should be clarified.
- * 10. Page 7, Location and Extent Section - The statement of no generalized delineation of the subbasin floodplain is not exactly true. Maps of flood prone areas and flood insurance studies provide generalized delineation sufficient for most floodplain studies and projects. However, further work is needed to specifically outline the floodplain area.

- *11. Page 9 - Numbers in paragraphs 4, 5, and 6 generally do not total those identified in paragraph 3. Although this may be correct because it represents a portion of the area of paragraph 3, it does make it difficult to understand the floodplain area. Suggest expansion of the numbers in paragraphs 4, 5, and 6 to clarify this.

- 12. Page 11, table 1 and paragraph 1 - In the 1979 flood, urban and rural flood damages were sustained. In the 1975 flood, why were no urban damages when the rural damages were eight times greater than those of the 1979 flood. If this is true, a brief discussion on flows might help explain this fact.

- *13. Page 12, table 2 - This table should be on page 11 if possible.

- 14. Page 14, Water Supply Problems Section - Has a rural water distribution system been developed for the area? If so, this should be identified.

- *15. Page 15, 1st paragraph - Marshall County did not have any acres irrigated in 1977.

- *16. Page 15, 2nd paragraph - Information is misspelled.

- 17. Page 16, table 3, last column - MNL should be explained.

- 18. Page 17, Public Perception of Problems and Solutions Section - This section contains statements and assumptions that are too strong, considering the data that are available to support them. Either some qualifications should be presented concerning the sources and age of the data or additional information discussing the many informal meetings and discussions with local interests at various committee meetings concerning water resource problems, needs, and solutions should be provided. Generally, 1967 and 1972 are sufficiently removed in time from the present so that the accuracy of this information, even if it were originally accurate, is questionable.

- *19. Page 17 - The Barr Engineering study should be cited.

- *20. Page 19, 2nd paragraph - It is unclear whether the in-migration mentioned is, in fact, in-migration or net migration? If it is not net migration, net migration data should be added. If it is net migration, it should be noted as such.

- 21. Page 19, last paragraph - What is meant by close-knit community? While some illustration of this term is presented, an explanation would be helpful because the term is ambiguous and could have many meanings.

- 22. Pages 19 and 20, Social Characteristics Section - Percentage figures would be easier to understand and compared if they were included in a table. Also, some comparison with similar data from another geographic area would be more informative.

- 23. Pages 20 and 21, Income Section - It would be helpful if the correction factor for converting dollars to 1979 dollars was included. Also, the distribution of income among the population (such as percentage below the poverty level, etc.) should be included. In addition, the general comparison of personal income and per capita income is to the State average. No comparison is made as to percent increase of State average income. Is the subbasins increase rate smaller than, greater than, or equal to the percentage of increase for the State.

24. Page 21, 1st paragraph - What was Kittson County's ranking of farm income level in 1977 and 1979?
- * 25. Page 21, Agricultural Section, line 2 - Round off "370,070 acraa" to "370,000 acres." Also the sheep and cow production is generally away from the flood prone area of the subbasin.
26. Page 21, Agricultural Section - In addition to the factors noted on yield per acre, harvested acres, and total production for particular crops, it would held understanding if gross incomes per acre for particular crops were included. This information would give a better view of the relative economic importance of each crop. Two other factors which would help are the differential in susceptibilities of crops to flood damages and the differential in costs per acre to plant particular crops.
27. Page 22, table 5 - What does SIC mean?
28. Page 23, Land Use Section - According to information identified later in the document, approximately 10.4 percent of the land is marsh. This accounts for about 74,000 acres. This figure does not agree with that identified on page 9.
- * 29. Page 25, 2nd paragraph - Aspen is misspelled.
- * 30. Page 27, 2nd paragraph - The relative abundance figure cited for the Hungarian partridge appears to be wrong, based on information provided by the U.S. Fish and Wildlife Service and cited in the other subbasin reports. It should be changed to 1/100 miles. In addition, when population indexes are cited, the report should discuss how the figures compare on a regional basis.
- * 31. Page 28, 2nd paragraph - Is the main stem equal to the Middle Branch? If so, the initial information presented in this document is wrong.
32. Page 29, Water Supply Section - Lake Bronson is not mentioned. Is it a water supply source or is it used in emergencies? This should be discussed.
33. Page 30, table 6 - This table is difficult to read.
- * 34. Page 33, 1st and 2nd paragraphs - It should be mentioned that the Lake Bronson site is on the National Register of Historic Places. Also, if a cultural resource survey has been completed, it should be mentioned.
- * 35. Page 34, figure IV - The map legend should identify the symbols used for the various recreational elements.
36. Pages 35 - 36, Cultural Section - No mention is made of surveys completed, anticipated, or needed in the subbasin. This information is particularly important if the known sites do appear to cluster along the rivers.
- * 37. Page 36, 1st paragraph - Nonstructural alternatives, if implemented, could also have a significant impact. Also, delete the last sentence because it is identical to one on page 33.
- * 38. Page 37, 1st paragraph and table 8 - "5.4 percent" should be "5.2 percent."

39. Page 39, 2nd paragraph - The following applies:

* a) Sentence 1 should specify that the State of Minnesota consider the eastern greater sandhill crane threatened, but the crane is not listed Federally as threatened or endangered.

* b) Sentence 4 should be changed to read: "The great blue heron is a species of special interest because it requires marsh-like wooded areas (such as coniferous swamps) for nesting, and this habitat type is rapidly vanishing." Coniferous swamps are not the only suitable habitat type; usually the nesting habitat is in tall deciduous trees which may be alive or dead.

40. Page 42, table 9 - Recheck employment increase projections. Some numbers are greater than population increases, others are identical.

41. Page 44, table 11 - Do other communities have average annual flood damages? If so, they should be identified. Also, the average annual equivalency factor should be identified.

42. Page 45, last paragraph - Are there plans to implement adequate threatment measures so that this would be the most probable condition?

43. Page 46, Without Project Conditions Section - This section appears to indicate that it is probable that no flood damage reduction plan, be it structural or non-structural, will be attempted in the future in the subbasin. Federally, this may be true, but on a State and local level this concept is in error. Is this intended? If so, it should be so stated.

* 44. Page 48, Structural Measures Section - It should be mentioned that Lake Bronson Reservoir is a State owned and operated facility.

45. Page 48, Nonstructural Measures - Does Kittson County have a floodplain zoning ordinance, or do other towns besides Hallock participate in a flood insurance program? Whatever the status, this should be stated.

* 46. Page 52, 2nd paragraph - Add "Federal" between "appropriate" and "engineering."

* 47. Page 52, 3rd paragraph, 2nd sentence - Change to read "tangible economic benefits or appropriate gains in environmental quality must exceed overall costs."

* 48. Page 52, last paragraph - After "...subbasin" add "from the information available." Change "the identified problems.." to "...this analysis of identifiable problems..."

49. Page 54, Formulation of Alternative Measures Section - Consideration should be given to agricultural levees and the Barr Engineering Study. Without these alternatives, the report is deficient.

50. Pages 56 and 57, Nonstructural Measures Section - Additional information on nonstructural alternatives should be provided (see general comment No. 1).

51. Page 58, 1st paragraph - See comment No. 5.
- * 52. Page 60 and 61, Impact Assessment Section - See general comment No. 5.
53. Page 64, No. 13 - It should be noted in each subbasin report that the probability of institutional and social boundaries being the same as subbasin boundaries is remote, at best. Since boundary overlaps exist, integrated basin-wide social and institutional analysis would be desirable.
- * 54. Page 65, No. 24 - Gaging is misspelled.
55. Bibliography Section - The following should be considered and/or added:
- a) State of Minnesota report from an architect-engineer contract entitled "Dam Safety Inspection Report for Lake Bronson Dam" (1978).
 - b) All references by the same author and of the same year should be ranked (i.e., 1979 a, 1979 b, etc.) so that these references can be distinguished.

END

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